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Canada as a Gold Producer, ***By Alexander Gray***

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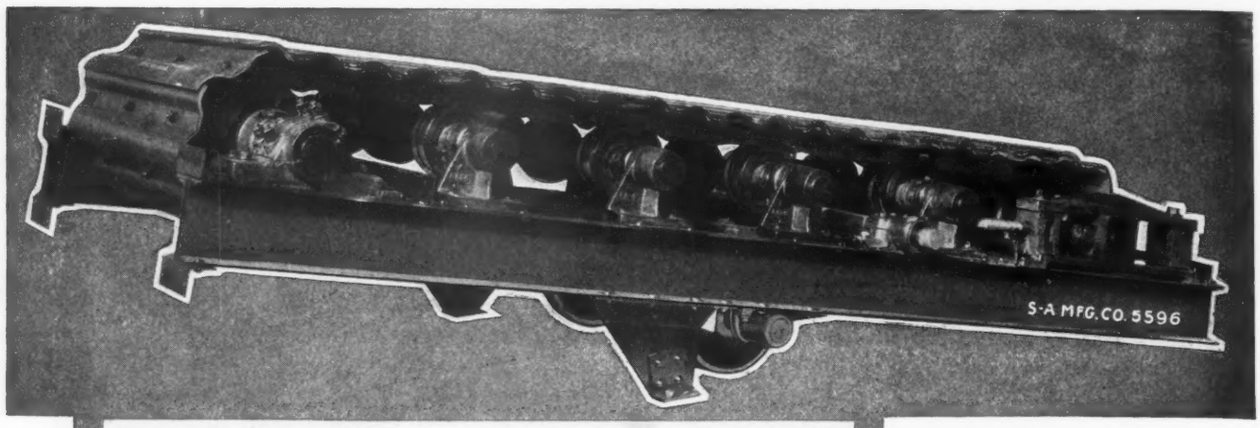
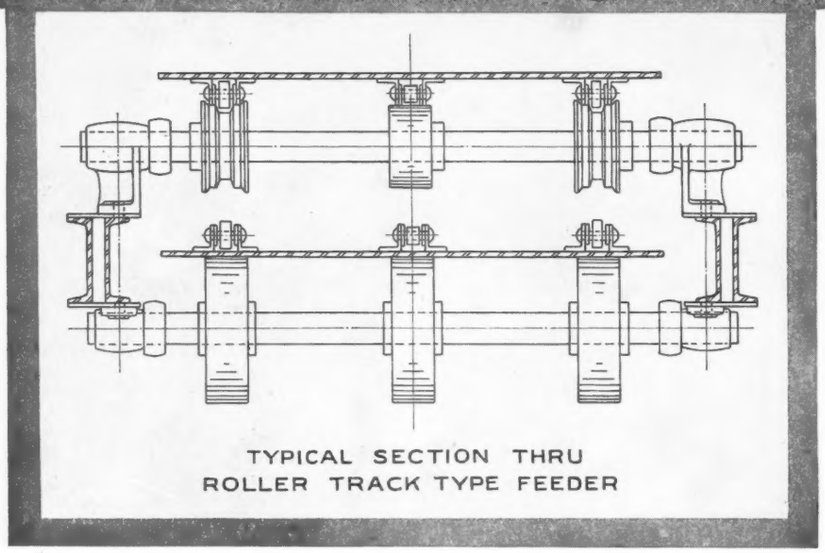
A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

April 8, 1922





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Trade Associations and Labor Associations

THE STRIKE SCHEDULED by the coal miners was discussed illuminatingly at a recent meeting of the Mining and Metallurgical Society of America by a coal operator who conducts a union operation and by another whose mine is on a non-union basis. The coal problem affects all industries and all individuals, and therefore interests us all. Both men plainly had the confidence and co-operation of their men. One works with a "pit" committee of union employees, but under such conditions that the balance of power and the ultimate right of decision rests not with the local or regional unions, but with the international union, which is dominated by the "central competitive field," including western Pennsylvania, Ohio, Indiana, and Illinois. The loss of time and money borne by the workers as well as the company due to strikes and other unnecessary interruptions was great in the union district, but the non-union operator reported no such wastage whatever.

The remarks we have made in preceding editorials with respect to trade associations apply pretty well also to labor unions. Each represents the same principle—the principle of organization, which is a right and is essentially a benefit to the organized parties and to the commonwealth. But just as there are good and bad individuals and good and bad trade associations, so there are good and bad labor unions. More accurately speaking, since there is "so much good in the worst of us and so much bad in the best of us," the individual may so conduct himself as to win public applause or be haled into court for punishment, for sinning against the common welfare; and the lesson is that he must not so sin. And the same applies to the trade association and labor unions.

As labor unions represent a greater mass of individuals, and as each individual has a vote, there has, perhaps, been a greater tendency among legislators to overlook labor union activities in restraint of trade, than those of trade associations. Price fixing by trade associations is held unlawful; yet unquestionably a certain amount of price manipulation is accomplished by their methods without their incurring censure, as in the conduct of the business of the California Fruit Growers' Association, and others that could be mentioned offhand; and even President Harding advised the farmers to market co-operatively. Price fixing by unions has been regarded more leniently, as in the coal situation, where the discrimination as to privilege allowed the miner as against the operator is more uneven than usual.

We do not intend to involve ourselves in the catch question as to whether or not labor is a commodity. It is not; but its cost is immediately translated into that of a commodity, in which it stands in the same category as taxes and management and the interest on capital, none of which are commodities; yet they are all translated into fractions of the price of a ton of coal, and that is the commodity which we must buy at the sum total so determined.

The remedy is the proper administration of the union with an eye to the *public* welfare; and it is doubtless for the purpose of encouraging labor associations as well as warning them, when their activities become so opposed to the public welfare that they become injurious instead of an element of strength, that the Department of Labor was organized. Thus the Department of Labor stands in the same relation to the labor association as the Department of Commerce does to the trade association.

Boston & Montana Again Questioned

IF OUR READERS will turn back to the issue of Jan. 28 they will find that we there editorially questioned the Boston & Montana project, then being extensively exploited by stock-selling. The outlook seems far from bright. We have just been reading a report on the property by C. S. Herzig. Mr. Herzig reports that estimates of the ore reserves which have been published are gross exaggerations and his "inspection of the mine demonstrated that the enterprise is threatened with disaster, due to the fact that not enough ore of commercial grade has been developed in the mine to maintain an output at all commensurate with the size of the mill. . . . The mine is not now on a self-supporting basis, and in my opinion there is no reasonable chance of it being so in the near future." It would seem that Mr. Herzig's examination was somewhat superficial, but it nevertheless confirms our opinion that the enterprise is open to question.

In the last six months no mining company has been so highly touted by all of the lighter class of brokers as Boston & Montana. A short time ago the stock of the Island Oil & Transport Corporation was given almost equal prominence. That company has just gone into the hands of a receiver, and although it seems to have earned about seven million dollars in one year, when the oil business was at its peak, it has never paid a dividend. We trust a better fate awaits B. & M.

We hope that those of our readers who are on the mailing lists of those brokers who publish market bulletins will be warned. It has been our experience that data which they publish are always inaccurate and often wilfully misleading. The mere fact that they always advise one to buy and never to sell is in itself significant to the thinking man. Most of these letters are written by poorly paid clerks who know absolutely nothing of the properties about which they rave.

It is unfortunate that the wolves of downtown New York usually select mining and oil companies for their attention. When they establish connections with incompetent mine operators the result is particularly dangerous, and tends to throw a light of suspicion on all mining enterprises, which, despite what Mark Twain said, are, as a general rule, straightforward enterprises, the same as most other lines of human endeavor.

A Felicitous Award

ON MARCH 7 the council of the Institution of Mining and Metallurgy voted unanimously to bestow its gold medal on Mr. Edward T. McCarthy "in recognition of his services to the mining industry and the mining engineering profession, and as an expression of the high regard in which he is held by his fellow engineers." To those who know Mr. McCarthy —and they are in every quarter of the globe—this award will seem as felicitous as the terms in which it is expressed. Of his services to the mining industry, we venture to mention his sterling good sense, which has recognized the need for applying sound business principles even to such a speculative venture as a mining enterprise. Of his services to the profession, we shall lay stress on the sincerity and integrity of his work, the expression of high character and a humane spirit. In mining operations there are many opportunities for a proper consideration of employees and for intellectual honesty toward employers. Mr. McCarthy has been an exemplar of both. The Institution has done honor not only to the recipient of its medal but to itself and to the profession in selecting for the award one who stands for the highest ideals of mining engineering as an art and a vocation.

One Is Born Every Minute

IN THE LATTER PART OF 1920 (page 948 of the Nov. 13, 1920, issue of *Engineering and Mining Journal*), we published an account of the muddled affairs of the Broken Hills Silver Corporation. The strategic organization of that foray upon the public was, you will remember, the incorporation of a mining property with a capitalization of 3,000,000 shares, par value 10c. each, and 2,000,000 shares of treasury stock, the stock being fully paid and non-assessable. The treasury stock was underwritten by a company known as the Fidelity, Finance & Funding Co., of Nevada, for a lump sum to be paid in installments, the aggregate purchase price being $380,000.

After manipulations through the San Francisco Stock Exchange, from aggregate sales amounting to several hundred thousand dollars by the speculating or gambling public, the mining company received a total of approximately $156,000 from this "Financing Company." The payments were to be used for the operation and equipment of the mine. The underwriting company placed its shares, together with large amounts of promotion stock, upon the market, and initiated a campaign to sell them at as high an advance over the price paid for the stock as possible. Frequent reports of "selling short" or failure to deliver shares when purchased attended these manipulations. The results of this campaign were more or less disastrous, and the control of the mine was taken over by a few sad and disheartened stockholders.

In this misadventure, you will also remember that George Graham Rice was the instigator and presumably the chief beneficiary. We next heard from George Graham Rice in connection with a Utah property, the Bingham-Galena, with similarly spectacular and disastrous underwriting and promotion of stock sales.

Recently, it was authoritatively reported to us that George Graham Rice's unquenchable belief in the truth of the caption which heads this editorial has led him to plan the flotation of another promotion known as the Idaho Gold Corporation, incorporated under the Nevada laws by Idaho and Utah men. The capitalization is 5,000,000 shares, of a par value of 10c. per share, 2,000,000 shares to be promotion stock. The Utah-Idaho Finance Company, a Nevada corporation having a capitalization of $50,000, par value, offers to buy the 3,000,000 remaining shares of the Idaho Gold Corporation on the basis of a sliding scale of prices and deferred payments; the details are not germane at this time. Of this money, 70 per cent is to be used in mine development. It appears that the management of the property is to be controlled by the Utah-Idaho Finance Company. The physical property of the company was called the Neptune Consolidated, formerly known as the Vishnu Mine property, and is in Elmore County, Idaho. It consists of lode claims, placers, and certain water rights. We know nothing about the property, nor can we find mention of it in recent volumes of "Mineral Resources," the "Mines Hand Book," or other general sources of information.

Let us look critically at the financial arrangements, for here we may get an insight into an obscure game of finance. Of the 5,000,000 shares, 2,000,000 remain in the hands of certain persons in lieu of cash payment for mining claims, property, or for miscellaneous services. In transactions of this kind, the promotion stock is usually held in a pool. This is of course to give sufficient time for the stock to mature in price, or in other words, to prevent "gumming up the game." The remaining 3,000,000 shares are to be purchased by the "intermediate" or underwriting company for a total sum of $600,000.

The ultimate owners of these 3,000,000 shares will own 60 per cent of the property. For every dollar they contribute, 42c. will, if the promise is kept, go into the mine, 28c. will indirectly enrich the promotion stockholders, and 30c. will be dissipated in a manner not disclosed.

Suppose it sells for an average of 40c. per share. This would return to it double the amount for which it bought the shares and would signify that the stock purchaser would have his money distributed as follows: 50c. to the "finance corporation," 21c. to the mine, 14c. to indirect enrichment of promotion stockholders and 15c. to an unknown direction or control. In other words, for every dollar the mine gets, the stockholder puts up $4.76. For a sale price of $1 per share, the figures are 80c. to the "finance corporation," 8.4c. to the mine, 8c. to promotion stockholders and 3.6c. to an undeclared and unknown purpose. For every dollar going into the mine, $11.90 leaves the stockholder's pocket (excluding the promotion stock).

We think that you will agree with us that this is indeed a type of finance that warrants the presence of a handy policeman. The dismayed and deluded stockholders of the Broken Hills Silver Corporation are pathetically holding their almost empty sack and peering around in the dim light of the flickering candle that George Graham Rice gave them to hold. Can this new foray, if it is allowed to go forth, result in any other than a similar outcome?

Remarks by the Editor

JUST A FEW WORDS about our contents this week and what we are trying to do. Please take special note of the article on the marketing of pyrites by our Western Editor, George J. Young, because this is the result of a plan we have had for two or three years and

have just succeeded in bringing to fruition. We feel that the marketing end of the mining business is least understood, and that it is perhaps the phase of the business that will pay best to study and comprehend, so that we may devise better methods for marketing, or profit by knowledge of existing conditions. The first step in this program is to find out the existing facts. Mr. Young's article does this for pyrite. It is the first of the series.

Every other week we shall publish another of the series till we have gone the round of the metals and the directly marketed minerals. Then we shall publish them all together in a book. We visualized and planned the book before we arranged for any of the articles. These articles are being written on a common plan, but by different authors. We have now on hand for publication an article on "Marketing Silver Bullion," by Parker D. Handy, senior member of the firm of Handy & Harman, which establishes the official New York price for silver (just as *Engineering and Mining Journal-Press* does for copper, lead, and zinc); another article on the marketing of arsenic, by F. Y. Robertson, vice-president of the United States Smelting, Refining & Mining Co.; one on the marketing of tungsten, by Charles Hardy, of Hardy & Ruperti, the principal American dealers in tungsten, and articles on the marketing of talc and of soapstone, by Raymond B. Ladoo, of the U. S. Bureau of Mines, specialist on the nonmetallic ores and a student of their marketing conditions. Other articles are in preparation.

As to the present issue, we want to point out briefly the diversity and the value of the contributed articles. An interesting article is that on the proposed mining of limestone through a four-compartment inclined shaft, written by J. H. Stovel, who has previously contributed papers on shaft-sinking to *Engineering and Mining Journal*. One thinks of the mining of limestone as purely a quarrying operation: so it will be interesting to read this article, especially as it discusses the method of sinking, the costs, records of progress, and an outline of the proposed mining system.

For the metallurgist, the article on "Lead Losses in Smelting Low-Grade Material" will be interesting, as a foreign viewpoint on smelting conditions, for certain differences are manifest between American and foreign practices.

Lately attention has been repeatedly directed to new mineral discoveries in various parts of Canada, so that the discussion on "Canada as a Gold Producer," by Alexander Gray, former editor of the *Canadian Mining Journal*, is timely, and it also is able. The author properly points out that Canada is a promising field for gold mining.

Mining geology in the South American field is represented by the articles on the Huantajaya silver district, discovered before the Spanish conquest of Peru.

We still have something to say about the elimination of waste in the mining industry, and we are going to say it, not with flowers, but with dollars. It is this: Our circulation department, after a long period of slumber of the disturbing kind, has waked up with an idea that is really brilliant. Our new circulation manager, George E. Andrews, springs this one: why not give a one year's subscription for $4, as per schedule, and two years for $6? "Bully!" say we, being always for economy and for the elimination, etc. You will at once inquire, how we can afford to lose so much money—an off-hand calculation might indicate that we would stand to lose $28,000 or $30,000 next year. And here's the secret: we make money out of the deal. And so do you. The red tape, stencil making, transferring, card indexing, literature-sending and all the rest of the complicated costs that come out of your second $4 is saved, and we are money in pocket—not so much as you naturally—you get 50 per cent—but we save enough so that we win also. This is the new journalism. Let the good work go on! Formerly a man who took *Engineering and Mining Journal* and *Mining and Scientific Press* for two years paid $18. Now he pays $6. Next year in this item alone we figure that we shall save the mining industry, if the men comprising it wish (and who wouldn't?)—around $50,000, by this reduced cost of subscription alone. If the mining industries could make similar increases in efficiency and reduction of costs all along the line they would soon be booming. Let's go!

The *Northwest Mining Truth*, published in Spokane, bewails the consolidation of *Engineering and Mining Journal* and *Mining and Scientific Press*, and opines that *Engineering and Mining Journal* has "never leaned towards the independent." Most extraordinary, we should say. We wonder if the editor of *Mining Truth* is himself independent; for if he is, he should recognize it in others. True independence is a quiet and assured characteristic; it goes with fairness, truth, and good will.

J. R. Finlay, writing personally to the editor, makes some remarks that will bear printing. Mr. Finlay has the faculty of making you think—twice. Unless you think twice you don't get him. He observes:

"I have noted with considerable interest the consolidation of the *Engineering and Mining Journal* with the *Mining and Scientific Press*. I hope and believe it will be a good thing. The combined paper ought to cover the country quite thoroughly.

"I have a distinct idea that the functions of technical publications are broader than most people believe them to be; for instance, I suppose you have gained the impression that nothing should be said in your paper that does not apply directly to mining. Of course that should be generally the case, because your paper or papers are avowedly technical journals for the mining industries; but have you thought of this view, that just such publications may and probably do have a greater effect on public opinion than the so-called popular papers and magazines? Take for instance a magazine like the *Atlantic Monthly*, which deals with public questions in a general way and with matters with general intellectual interest: I doubt very much whether it affects public opinion as it is perhaps popularly supposed to affect it, because the kind of people who read the *Atlantic Monthly* are not very active in the ordinary pursuits by which people get a living, but ten or twelve million people in this country get a living through mining, or from the industries that are based upon mining, and if they can see that they can get that living better in one way than in another way, they are going to stick to the way that is most promising. When you deal with ten or twelve million people you deal with politics. Therefore I believe that inasmuch as economics is a more fundamental subject than politics, trade journals such as yours have a deep influence on politics through public opinion. It does not seem to me that I am expressing myself very well, but my general idea is that your paper should go into the whys and wherefores of the processes by which general prosperity is furthered or retarded."

A Golden Myth

By T. A. Rickard

AT A RECENT MEETING of the Mining Committee of the Spokane Chamber of Commerce "a voluminous brief" was submitted by Colonel Chester T. Kennan on the subject of an alleged conspiracy for the control of the gold supply of the United States. That Mr. Kennan's statement was voluminous I can well believe; like a cuttlefish, he covers his tracks with an inky darkening of the waters of thought—in short, he is a man that writes freely on subjects concerning which he is inadequately informed; he ought to be a reporter on a Hearst newspaper.

This is not the first time that the "Colonel" has uncovered a mare's nest. Two years ago he unearthed a "swindle" that had been perpetrated by a "McAdoo syndicate," and at the same time he asserted in public that the smelters were paying only $20 per ounce for gold that they sold—in Europe presumably—at $35 per ounce, and that they were "pocketing the difference." In regard to his latest "conspiracy," he has misled many people in the Northwest by means of a myth born of his own disordered imagination. Mr. Kennan's "conspirators" are the directors of the Federal Reserve Bank. He charges the directors with having dishonored the notes of the bank by refusing to redeem them in gold; nay, even the Government of the United States is in a conspiracy to withhold gold coin from the people, according to the "Colonel." His statements would be important if true. They are not. He can obtain from his banker a draft on a Federal Reserve bank and exchange the draft for the equivalent in gold coin, or, simpler still, he can get what gold he wants at his bank on his personal check up to the limit of his credit. His bank is under no obligation to do this, but it will. Anybody can get $1,000,000 in $20 gold-pieces tomorrow without any hocus-pocus. The Mint of the United States will sell gold bullion to Mr. Kennan on the terms fixed by law—namely, not less than $5,000 worth at $20.67 per ounce. Moreover, he can sell his gold to the Government at the same price, but not less than $50 worth at a time. The United States maintains a free market for gold. At the present moment any outward movement of gold would be facilitated by those in authority, for there is in this country today $4,000,000,000 in gold, which is more than is needed.

Mr. Kennan asserts that gold is now worth $40 per ounce on the foreign market, and inferentially that our miners are not receiving the right price for it, seeing that they can sell it for only $20.67. He asserts that most of the world's current supply of gold comes from mines in the British dominions and that this British-mined gold is sold in London for 125 shillings per ounce; so he deduces the existence of a "premium" of about 47 per cent, because normally gold sells in London for 84.95 shillings per ounce. He overlooks or disregards the fact that the payment is made in paper currency that is at a discount equivalent to the so-called premium —that is, the gold sovereign was worth 47 per cent more than the paper pound sterling on the day when gold was selling for 125 shillings. Great Britain has suspended specie payment, while the United States maintains its currency on a gold basis, so that the price of gold in this country is maintained at the normal rate. Since the date when the "Colonel" relieved himself of his "brief" the rate of exchange has improved, the British paper pound has gone up to $4.44, and the price of gold in London has gone down concurrently to 94 shillings per ounce. If a mine-owner ships gold from California to London he will receive the quoted price, which will be as much more proportionately than the normal in paper shillings as the shillings are below normal in exchange with the American dollar; in other words, the dollar remains on a parity with gold, so that the price of gold from Johannesburg in terms of dollars or sovereigns has not changed from the normal ratio, as it was before the war.

It is not surprising that many people are mentally adrift on this subject, because not only such irresponsible scribes as Mr. Kennan but the so-called statisticians of the American Mining Congress have issued much half-baked propaganda on the gold problem. In the effort to win the support of the mining community, the Mining Congress, in its monthly "Journal" and in loose-lipped talk at its conventions, has spread the fallacy that there is something sinister in the selling of South African gold in London at a "premium." The McFadden Bill gained support partly by reason of a popular misunderstanding on the subject. Of that attempted legislation I shall say only that it might have been justifiable during the war, but the conditions that excused such a piece of special pleading have passed, and the gold-mining industry of this country, I am glad to add, is now in a position in which it needs no fictitious aid. It is regrettable that the officials of the Mining Congress should have played a part in misleading the public on matters concerning which they could have informed themselves correctly. For example, the notion that we needed an enlarged supply of gold from domestic mines in order to fortify the gold reserve in the U. S. Treasury was mistaken, for during the last five years the inflow of gold from abroad has been much more than sufficient for that purpose. Moreover, the idea that the gold produced from our own mines necessarily would be available for such a purpose was childish, for the simple reason that gold does not remain in the country of its origin; on the contrary, it is at the mercy of the tides of commerce and moves outward or inward in accordance with the balance of international trade. The gold of South Africa will come to New York so long as the United States is a creditor nation and the metal is needed to settle obligations between the peoples of Great Britain and the United States. Moreover, the amount of gold produced annually in this country is a mere drop in the bucket of international commerce. Recently, our mines have been producing about fifty million dollars' worth of gold per annum; what is that compared with a foreign trade of twelve to fifteen billion dollars per annum? As much as ninety million dollars of gold has been imported in one month—namely, October of 1920. These are simple facts that have been ignored by the Mining Congress in its efforts to push the passage of a gold-bounty bill through the national legislature at Washington. The miner is to be congratulated that he can sell his gold at the old stand at the old rate, while the general level of commodity prices has gone down nearly 50 per cent in two years.

DISCUSSION

Moroccan Phosphate Deposits

Operations Subject to Local Governmental Decrees —Not Competitive With American Product Unless Improved Methods Are Adopted

In the *Engineering and Mining Journal* of Feb. 11, 1922, Warren M. Foote has an article on the "Non-Metallic Minerals," and on page 246 of that article I note the following statement: "Exports have been seriously affected, and those well informed appear to feel that American export trade of phosphate will be lost in a few years to the Moroccan deposits. Hundreds of millions of tons of rock which is said to be geologically the same as the Tunisian rock have been uncovered by the French government in Morocco. The French are hopeful of eventually controlling the entire European market, following their shipment about the end of 1921 of a first lot of 500 tons."

In the spring of 1920 I was associated with some French mining engineers, and made an examination of the above-named deposits, and I estimated that they contained 1,000,000,000 tons. These deposits were discovered in 1912, about ninety-three miles to the southeast of Casablanca, near El-Boroudj. It soon became evident that they were of considerable extent and promised formidable tonnage, because successively the discoveries at Oued-Zem, Marrakech, and Chichaoua were announced. The last-named deposit was said to be not so rich but of considerable tonnage and extent. Finally, other layers were discovered, of which up to now little has been known. Research work has been continued by the Moroccan administration and by individuals.

The deposit of El-Boroudj, the first discovered, stretches from the east to the west over a zone of sixty-two miles, from Oued-Zem to Dar-Chafai. Its northern limit approaches Guisser, and to the south the boundary line of the bed is the El-Boroudj cliff, which looks down on the plain. At this point the erosion has caused the phosphate formation to disappear, but one sees it reappear further on in the region of El-Kelaa. In the valleys cut out in the table-land by the streams of water descending toward Oum-Er-Rebia—valleys which follow the road from El-Boroudj to Guisser—beds are to be seen midway on the slope.

From research undertaken by the mine service of the protectorate it is estimated that the deposit recognized in that zone will reach a thousand million tons of phosphate.

Reports and publications on these riches of Morocco foresaw their rapid working in the perimeter of El-Boroudj, Ouallatou, and Biar Meskoura, and more notably in the southern and western parts of that perimeter, where the cliffs permit the opening of the trenches uncovering the bed of phosphate. On other points shafts of moderate depth, or trenches on the sides of the cliffs, would allow easy and remunerative working. Elsewhere exploitation would have to be by tunneling.

The localities are of technical and commercial interest because of the apparent stratigraphic regularity of the formation and the facilities for prospecting. It is said that this region contains more than 100,000,000 tons of phosphate grading 65 per cent for the upper bed. Twenty-three analyses, representing a number of samples, show from 49 to 73 per cent bone phosphate of lime, with an average for all samples of 62.74 per cent. The layers of phosphate of the deposits are not continuous through the district above described, and their value naturally varies with the grade of the beds.

At many places the phosphate is too poor in grade to be commercially recovered, and this is often the condition, as in Algiers and Tunis, of the thickest and most important beds.

The formation at El-Boroudj is about ninety-eight feet thick, with four beds of phosphate, and at Oued-Zem sixty-five feet, with three layers of phosphate. In both deposits the phosphate is grayish and easily friable. The phosphate beds are separated by calcareous beds, clays, and a low percentage of phosphatic marls. In some places six beds are shown, two of them only fifteen to twenty inches thick, and not workable; two forty to sixty-four inches, and two sixteen and twenty-six feet thick.

Political Status Uncertain

Concerning the working of these deposits there have successively been proposed adjudication, cession to an Anglo-Italian group, and sale of the deposits or part of them to the United States to pay off the French war debt to this country. Some were strongly against the adjudication, which, at the current rate of exchange, would appear to be greatly to the disadvantage of France. Certain groups in Algiers and Tunis have been publicly censured for causing delay in the working of the deposits, others maintaining, however, that the phosphates, constituting a rich asset of the Moroccan state, should be developed by the state for its own profit.

Actually, the future working of the deposits is regulated by the Dahir of January last (6 Djoumada 1, 1338), which reserves solely to the Makhzen their research and working, but with the understanding that consideration be given to the rights of prospectors which were acquired before the said Dahir was in force. The Dahir of Jan. 19, 1914, afforded to foreign groups a possibility of making mineral researches.

It is understood that the French government opposes state development, and consequently there is no definite understanding as to the manner in which the work is to be undertaken. The French administration mined a limited amount last year. At that time it was clear that the development of the deposits had been the sub-

ject of discussion and that the grade of the phosphate had been grossly exaggerated, with the sole purpose of securing a big loan to the Cherifian state from the French government. It was rumored that the French government has granted to the Cherifian state the right to spend 700,000,000 fr., and I understood at the same time that 32,000,000 fr. was to be used in the construction of a railroad from the mines to the seaboard, and for improvements at the port and works in the mines.

GRADE GENERALLY INFERIOR TO AMERICAN PRODUCT

Concerning the grade of the phosphate, twenty-three analyses of material from the district of El-Boroudj include two analyses below 50 per cent; eight from 50 to 60 per cent; seven from 60 to 70 per cent, and six from 70 to 73 per cent, bone phosphate of lime. The twenty-five analyses of the district of Oued-Zem show five from 50 to 60 per cent; seven from 60 to 70 per cent; eleven from 70 to 80 per cent; and two slightly above 80 per cent. But it has been said that it would be wrong to attach a great importance to a few analyses that cannot represent the composition of such an immense tonnage of phosphate. Further, and significant in this connection, is the fact that the deposits which were to be worked are those that are now being worked in the district of El-Boroudj, and yet they are poorer, and situated at a greater distance from the seaboard, than the deposits of the Oued-Zem region, the so-called 80 per cent deposits.

The best analyses came from the Oued-Zem district, but the average grade of the phosphate beds is probably not much higher than the beds of other regions, since, as already stated, it had been decided to open the deposits of El-Boroudj and to build a railroad, which I understand has been done, from there to Casablanca.

The deposits found in the region of Mogador are of low grade: 40 to 45 per cent tricalcium phosphate.

All phosphate that has been shipped from Florida to Europe has been under contract to run not less than 77 per cent bone phosphate of lime, not over 3 per cent of iron and alumina, and 3 per cent of moisture. Averages analyses of the best of the Moroccan phosphate ore are only 62.74 per cent tricalcium phosphate.

ACID TREATMENT OF LOW-GRADE ORES NOT EFFICIENT

Before the Great War, Florida exported 1,400,000 tons of phosphate of grade superior to either that of Algeria or Tunis, the Florida phosphate running from 68 to 75 per cent for pebble, and the hard rock 77 per cent and over. Considering the fact that the Algerian and Tunisian phosphates are sold under a guarantee of from 53 to 58 and 63 to 68 per cent, there does not seem to be much danger of Florida's export trade being effected, if quality is taken into consideration, and if the future is to be judged by the past, and all phosphate ore shipped from America to Europe should be sold under a contract guarantee, as heretofore. The Algerian, Tunisian, and Moroccan phosphate cannot compete with the American unless the foreign miners should resort to some improved method, as a modification of the Cottrell process, for the recovery of the phosphoric acid. It is self-evident that the use of the acid treatment in low-grade ores does not pay and, in fact, entails great loss to miners even in the manufacture of high-grade ore. STRAUSS L. LLOYD.

Inverness, Fla.

Mining Engineers a Commodity

Are mining engineers a commodity? If so, why not have us listed on the Stock Exchange, along with wheat and corn? Witness the following:

A certain mining engineer, technically educated and with some twenty years' experience in the operation of mines, was requested by a Boston syndicate to act in the capacity of general manager of two mines, one in Utah and one in Nevada. This particular mining engineer is one of those lucky ones who has been able to hold on to a job through this long, unhappy period.

The Boston syndicate asked the engineer to name his price. In reply he named a moderate salary—less than would have been considered normal before the war. The answer he received was as follows: "There are some experienced business and mining men on the board, and they are proceeding with the idea that economy must prevail. One of the men, well acquainted with mining, offered to supply a manager at a salary of $200 a month, whom he could recommend most highly."

This Boston syndicate has no office in the West and suggested that if the manager needed one he could pay for it out of his salary. One of the mines referred to is a producing and self-supporting property, and the miners are paid $5 per day, but the manager of the two mines, because, they added, "there are so many first-class mining engineers out of employment," is expected to give all his time and pay for an office for a compensation of $200 per month.

Let's hope that tomorrow's market report reads about as follows: "Moderate new upturns in the price of wheat. Corn, oats, and mining engineers were governed by the action of wheat. M. Es. closed at 201½."

Salt Lake City, Utah. THE GUILTY ONE.

Replying to Dean Probert

A letter of Dean Frank H. Probert's appeared in the issue of March 4 commenting on my article in the Jan. 7 issue on the College of Mining of the University of California.

The following are the points, in order, which he makes in this letter: First, he seeks to discredit the witness; second, he ridicules my article and says, "See what we do"; third, he says, "See how our courses compare with those of other colleges"; fourth, he enumerates various accomplishments of students and graduates; fifth, he points to entrances from other schools, and lastly he marshals some old "grads" and tells us to look at them.

This is all very well, but if Mr. Probert will read my article over in a more generous spirit he will find that I have commended the mining course and that I have certainly not reflected in any way upon the graduates of the school. I have made no comparisons with other schools. My article, in common with the other articles in the series, was designed to be critical, and I felt free to raise a number of questions which are common to most mining schools. In the instance of the mining course of the University of California, I found only partial answers to my queries, sufficient in most instances, however, to warrant raising the query.

Two important questions have received my attention in all cases: First, how far has recent discussion affected the curricula of mining colleges and, second, in what way is the total time of the undergraduate utilized? In handling the first question, I have gen-

erally noted the absence or presence of courses bearing upon the question. In answering the second, I have made a time analysis from the schedules as published and obtained information from instructors as far as possible upon the time requirement outside of classes. In some schools I have found that a definite policy was being followed, but in the instance at hand I found only a loose system apparently loosely administered.

In indicating trends, I characterized the mining course as a service course. This is no reflection upon the course nor upon the men who take it. It is an attempt to make the educational problem more definite by determining, first, the average ability of the men who constitute a class, and, second, finding out just where these men may find lodgment in the industry. Is it not true that the bulk of the men graduated from our schools find service positions? I exclude the fortunate ones who may have special assistance as well as the men of exceptional ability. If this be so, why should not a course be definitely directed to the needs of the "average student"?

Giving Mr. Probert the benefit of every doubt, I can see nothing in my article that requires change or restatement. It stands for what it is—an independent estimate of the mining curriculum. I can see no reason why I should not definitely express my opinions and deductions in the case in point. In regard to Mr. Probert's aspersions upon myself, I can only say that they are unpardonable. GEORGE J. YOUNG.

San Francisco, Cal.

The Hope for the Graphite Industry

I have read with interest G. H. Clark's article in *Engineering and Mining Journal* of March 11 on the graphite industry in Alabama. I note that he favors a tariff for graphite as necessary for the revival of the industry. It is curious that the miners will sit around and depend upon Congress to pass a tariff that at best will only be a makeshift and in the end will not benefit them to a great extent. It would be better if we would get down to hard work, and study to make it possible to compete with the foreign product. This can be done, and when it is done the industry will be on a firmer basis than it will by the establishment of a high tariff, as every change in the party in power will make for a change in the tariff policy, and it would be much better for the industry to be able to compete without such uncertain help.

The fault lies with improper methods and reckless expense of money in large buildings and equipment without regard to the most important essentials, such as the proper layout of the plant. In nearly all if not all of the mills in Pennsylvania these essentials were ignored, and failure of the plants was a foregone conclusion.

The mines in this section can all be made to pay a good profit if properly built and efficiently equipped and managed. It is necessary that the mine be close to the mill, and that a good supply of water and an easy disposal of the tailings be provided. The next consideration is the proper concentration of the flake with the least possible amount of machinery. The flotation machine is the best means of making a high-grade concentrate with a high extraction, and if handled properly a 98 per cent extraction of the loose flake can be obtained. Flotation machines can be installed at a small cost, and the upkeep and repairs are trifles in comparison with other types of concentration machinery. One machine will produce from three-quarters of a ton to a ton of concentrate daily at a cost of about one-half a cent a pound. The proper milling of the concentrate has been correctly done with burr mills.

The cost of a plant to produce five tons of 80 per cent concentrate daily would be less than $5,000, not including the land. In this region a plant of the capacity above stated can be constructed at the cost named, at nearly all of the available mines, and from what I know of the Alabama mines similar conditions prevail there also.

Another thing that should be looked into is making a commercial product of the dust produced by the burr mill in refining the flake. This material can be made into a high-grade lubricant at small expense, and in the future more and more graphite will be put to this use.

I am of the opinion that a high tariff will work for more reckless waste of money in this industry and will further harm those interests which are honestly attempting to make a success of the venture.

Chester Springs, Pa. HARRY A. SCHMEHL.

The Miner and the Forest Service

Anyone who has had anything to do with mining in the Western states in recent years must have been struck by the hostility which the miner feels for the Forest Service. Personally, I have regretted this and have endeavored wherever possible to allay this irritation. It is evident, however, that the miner is often right in his contention that the Forest Service is hostile to the mining industry. As an evidence of this I would call attention to a recent decision of the U. S. Land Office, at Cœur d'Alene, Idaho, as it shows clearly the lengths to which the Forest Service will go. The case is that of the Hamburg-American Copper Mining & Milling Co., which sought to patent claims located *prior* to the establishment of the forest reserve in which they are now included, which application for patent had been protested by the Forest Service. The Land Office in its opinion says:

"The mining claims here involved were located more than twenty years ago and are in an undeveloped part of the Cœur d'Alene mining district. The land involved was withdrawn from homestead entry and included within the Cœur d'Alene national forest, subsequent to the location of the mining claims, nearly all of which are covered with a substantial growth of timber.

"But at the time of their location these claims were very difficult of access and remote from market. In case commercial ore is found, all of the timber now on the claims would be necessary for use in the operation of the mine. At the time of the location of these claims there were large areas of public land bearing equally valuable timber much more conveniently located with reference to market which were subject to entry under the timber and stone and homestead laws; so that it appears to us that any reasonable person of average judgment seeking to beat the Government out of title to valuable timber would have chosen some other easier and cheaper method, for in this case more than $15,000 has been expended in apparent good faith in trying to develop the group into a mine. We are convinced that these claims were located in entirely good faith without thought of speculation in the timber."

The Land Office is to be congratulated on the soundness of its reasoning and the justice of its decision. The case serves, however, to show the obstacles which are constantly thrown in the way of mining development in the national forests.

Moscow, Idaho. FRANCIS A. THOMSON,
Dean, School of Mines, and Director
State Bureau of Mines and Geology.

Geology of the Huantajaya Silver District

Characteristics of the Country—Discovery Antedated Spanish Conquest of Peru—Limestones and Porphyritic Rocks Associated — Different Fault Systems — Partial Explanation of Genesis

By Herbert G. Officer

THE MINING DISTRICT of Huantajaya is in the Province of Tarapaca, Chile, about eight miles due east of Iquique. The elevation at the mines is 850 m. above the sea, and 600 m. of this is represented by the abrupt drop from a hilly table-land to sea level. Going to the mines from Iquique the 600 m. rise is accomplished in the first two miles, and once the plateau is reached the grades are easy. The district is about two miles long by one mile wide, the length being in the direction of the average strike of the lodes, N. 60 deg. E.

Eight miles from Huantajaya, in a southeasterly direction, is the silver district of Santa Rosa, once richly productive but now idle. Four miles in a northwesterly direction, in Huantaca, is another group of mines which once produced small quantities of silver-cobalt ores. The latter mines were never large producers, and have only paid expenses. Twenty miles to the east of the Huantajaya mines lie the "pampas" or "salitre." The nearest railway to the Huantajaya district is the Nitrate Railway, which passes eight miles to the southeast. At present access is by horse, and transportation of supplies by pack train or cart. The cart road is so arranged that gradients are easy, but even under the conditions noted, a five-mule cart is limited to a net load inward of one ton and a net load outward of two tons.

The climate is excellent, as might be expected in a desert table-land. The total absence of rainfall implies a lack of vegetation. For nine months of the year, September to June, the days are cloudless, with cool breezes from the sea. The nights are always cool. During June, July, and August, notably the latter month, mists are prevalent and occasion the only natural discomfort that the inhabitants have to suffer. The water supply for the village and mines is obtained from a branch pipe line connecting with the line from Pica to Iquique. The water is of an excellent quality for domestic purposes, but leaves much to be desired when used in steam boilers.

Historical Aspects of Great Interest

The first discovery of silver in the district was before the Spanish conquest of Peru. The Indians worked the mines in a superficial manner, but only from the outcrops in the western section; and these mines undoubtedly contributed to the fabulous wealth of the Incas. With the advent of the Spaniards, work was done on a larger scale, and the 70-m. mantle of alluvium covering the eastern section was first penetrated by them. The exact date of the discovery by the Spaniards is not known, but they knew of the mines as early as 1540. Copies of a surface plan made by one O'Brien for the Viceroy in 1765 are now at the mines, and the original is in the museum in Madrid. In 1826, when Darwin paid a visit to the Tarapaca nitrate fields, he passed on horseback between Huantajaya and Santa Rosa. He remarked that the mines seemed to be very little worked at that time.

As will be shown later, the district can be considered in four parts. The eastern and western are separated by a fault of 200 m. vertical displacement, the eastern side being stratigraphically lower; and these are divided into upper and lower "regions" by the 100 m. sheet of porphyry. It is interesting to note that the Indians worked the western part where the lodes outcrop in the first region limestone. The Spaniards worked the lodes in the eastern section in the first region limestone, but had to pass through 70 m. of unconsolidated con-

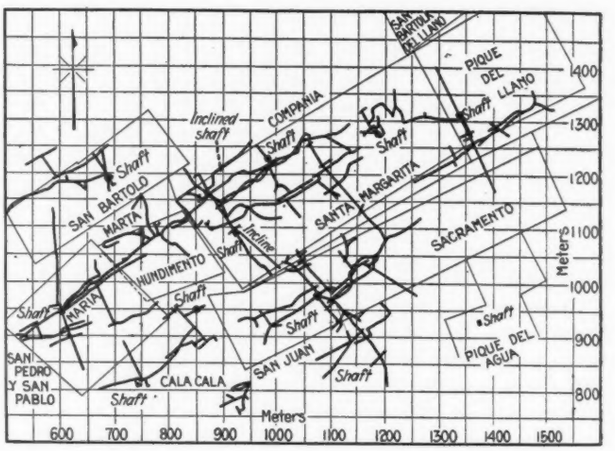


Fig. 1. Eastern section Huantajaya mines

glomerate to do so. Later the English and Chileans penetrated the porphyry in the western section and found big bonanzas; and still later, in 1911, a company was formed to work the lodes below the porphyry in the eastern section, but the work was not continued.

The hills are all rounded, and their contours smoothed, by deposits of debris from the weathered rocks. The valleys are covered by thick mantles of alluvium washed from the hills. The eastern portion is practically level, due to the filling of an old river bed and flood plain by a 70 m. mantle of alluvium or "accarreo." The western part of the district is about 150 m. higher than the eastern and is cut by numerous small gulches. The outcrops of the lodes are always marked by small ridges or welts where the mineralized vein has been more resistant than the unaltered rock.

In the productive part of the district, the rocks are limestone, but the surrounding country is made up almost entirely of igneous rocks. Granites and diorites predominate. Quartz-porphyry is less abundant, but is present in considerable areas. In Santa Rosa, to the southeast, and in Huantaca, to the northwest, the sedimentaries found are the same as those occurring in Huantajaya. In Santa Rosa, there is some variation in the character of the limestones, which are more siliceous, but the thickness and arrangement of the intrusives are significantly like the Huantajaya formations.

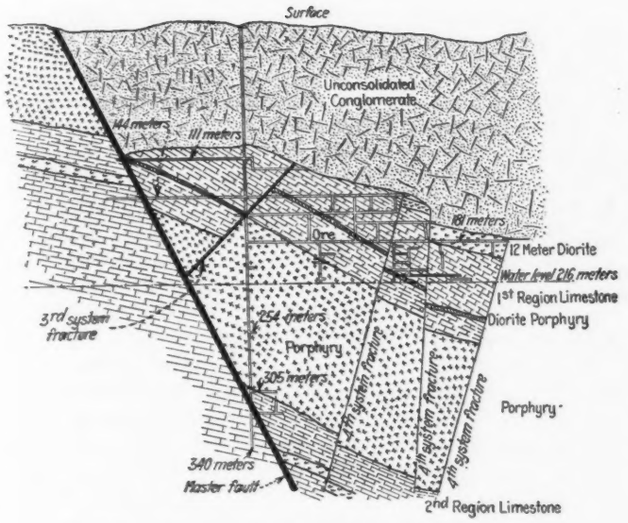


Fig. 2. Vertical projection of Sacramento lode

Fig. 2 shows the arrangement of the rocks on either side of the fault of 200 m. displacement. It is to be noted that some of the rocks shown in the eastern part are now eroded from the western section. Beginning at the top, the following formations occur:

70 - 90	m.	Alluvium (Quaternary)
30	m.	Limestone
6 - 8	m.	Shell limestone
16	m.	Limestone (Jura-Triassic)
12	m.	Diorite, medium grained
50	m.	Limestone, reddish, ore-bearing
6	m.	Diorite, fine grained
30	m.	Limestone, blue-black, ore-bearing
90-150	m.	Quartz-porphyry, reddish
30 - 40	m.	Limestone, white, slightly sandy, ore-bearing
12 - 15	m.	Diorite
80	m.	Limestone, with diorite intrusions

The alluvium covers only the region east of the master fault. It is made up of limestone, diorite, porphyry, felsite, and other rock fragments. These fragments are sharply angular, and there are few large boulders. At a depth of 30 to 50 m. there is a layer of volcanic ash 1 m. thick and in some parts of the district this is mined for the making of "sapolio," oil filters, and similar products. This stratum extends throughout the old river bed now occupied by the alluvium.

The limestones, which are the rocks influepcing ore deposition, grade from a sandy, white rock, through red and bluish-black to white again. The first 30 m. of limestone listed in the geological column are eroded from most of the district, and none of the lodes are known to intersect these rocks. The shell limestone is found throughout the district and has been useful in correlating the strata. It is made up of shell remains. The 50 m. bed of reddish limestone grades into the blue-black limestone below, with the diorite presenting an unnatural line of division. This limestone is rather siliceous in places, contains considerable ferric oxide, and does not seem to have been favorable for ore deposition. Fossil ammonites found in this bed determine its age to be Jura-Triassic.

Quartz-Porphyry Intrusive Throughout District

The 30 m. blue-black limestone is probably made up of the same material as the shell limestone, but metamorphism has been so complete that it appears as a dense, fine-grained, exceedingly pure limestone. The limestone is often intruded by stringers and thin sheets of diorite porphyry. Below it is found the reddish quartz-porphyry. The quartz-porphyry, found everywhere in the district, is uniform in character, although its thickness varies considerably. The lodes in passing through this large intrusive sheet have everywhere proved barren. They are pinched into mere veinlets of calcite. Where the limestone is in contact with the porphyry it shows considerably more metamorphism than elsewhere.

The 30 or 40 m. of limestone below the porphyry was the most richly productive of all the strata, although it is not as pure a limestone as the blue-black variety immediately above the porphyry, nor does it seem to be so greatly metamorphosed. The last known 80 m. of limestone is similar to the limestone immediately below the large intrusive sheet, but has never been productive.

The three sheets of diorite are alike in character and texture, the middle one being slightly finer grained. Each sheet is remarkably uniform in thickness throughout the district. Upon their contacts with the limestones the calcination of the latter, both above and below, is plainly visible. The diorites produced an effect similar to that of the porphyry in their action upon the ore deposition.

Four Periods of Faulting

The district has been subjected to four distinct periods of fracturing. The periods or systems will be treated in the order of their economic importance, which, except in relation to the first two, is also, probably, their chronological order. Fig. 3 is a plan of the systems, which are as follows:

First, the main silver-bearing lodes, striking N. 50 deg. to 60 deg. E.; second, the cross lodes (barren), striking N. 80 deg. to 85 deg. E. (probably formed previous to the first); third, the system of faults striking N. 40 deg. to 45 deg. W.; fourth, the faults related to the master fault. In the western portion of the district, including all that area not blanketed by the alluvium, two distinct series of vein fissures are found.

The most important series of veins, economically, are those striking N. 50 deg. to 60 deg. E. and dipping from 70 to 90 deg. S. These veins show remarkable constancy in dip, strike, length, and depth of mineralization. In most formations, and always if large and well formed, they show a relative displacement vertically of from 8 m. in one to a few centimeters in others, and the greater this faulting along the fissure the greater has been the importance of the lode.

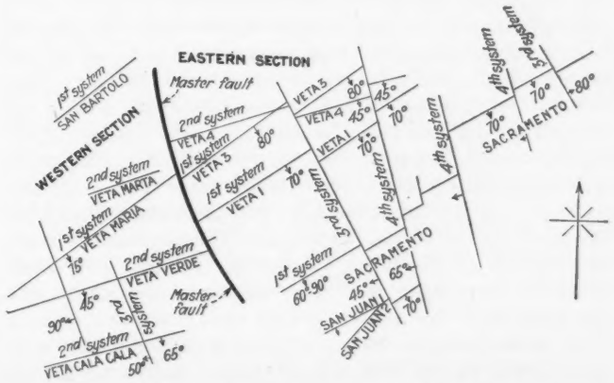


Fig. 3. Plan of the four systems of fractures

In some of the fractures displacement is not evident. They are narrow and barren, and probably resulted from the same stresses which produced the more important lodes. These minor fractures of the first system, although sometimes mineralized near the surface, seldom extend, except as mere stringers of calcite, to the deeper portions of the mines.

In attempting to generalize about the lodes of this system one is at once confronted with the necessity of distinguishing between those of the eastern section and those of the western section. In the eastern part of the district there are about 100 m. of limestone and diorite above the porphyry, whereas in the western part the porphyry outcrops.

The Veta Maria is a good example of the first system lodes in the western area. From the master fault it extends S. 55 deg. to 60 deg. W. for 420 m. to its intersection with the Verde lode. The intersection occupies a distance of about 100 m., where the two lodes are indistinguishable, and after their separation it extends for 200 m. S. 60 deg. to 65 deg. W. The average dip is 80 deg. south. (It is to be noted that the intersection with the Verde deflected the Maria about 5 deg. further west). This lode has been explored for 100 m. below the porphyry, but was only productive in the 30 m. of limestone adjacent to and below the porphyry. In some occurrences the ore extended up into the porphyry for several meters. The mineralization was not defined by well-formed rock surfaces, and deposition of ore in the adjacent limestone seems to have been the rule. The parts of the lode now remaining show no banded structure and no regularity of deposition, and it is difficult to tell where the vein filling ends and the wall rock begins. The wall rock is usually metamorphosed and impregnated with chalcocite, and is stained with copper carbonates. Judging from reports, and from the appearance of the stopes, the richest parts of the orebodies were within limestones which had been affected by the intrusions of porphyry and diorite. The average width of the lode is about half a meter, though in the rich parts payable ore was extracted from a total width of 2 m., and at the intersection with the Verde lode the stopes are 10 m. wide.

Chief Silver Minerals, Native Silver and Argentite

The silver minerals found in this lode were chiefly native silver and argentite, and more rarely cerargyrite. The gangue minerals were calcite, chalcocite, malachite, azurite, and more rarely silver-bearing galena. It is to be noted that native silver was the predominating mineral, and that galena, chalcocite, and argentite were the only sulphides present. There is evidence, in the presence of limonite, of the former existence of iron pyrite.

As an example of the first system fissures east of the master fault, the Sacramento lode is given. This lode, although much faulted, was explored for 700 m. on an average strike of N. 55 deg. E. The dip, owing to faults, varies from 65 deg. to 90 deg. S. The most productive part of the lode was between the 12 m. and 6 m. diorite bands, and in few instances has ore extended down to the porphyry. The ore shoots were remarkably persistent in following certain preferred strata of limestone. Owing to the dip of the strata and the subsidence caused by faults, the rich zone is now often found under water. The Sacramento lode has been displaced by two sets of faults and a series of "arrastras," and consequently presents a shattered appearance. The dip is variable because some of the faults were rotary in character. The richest ores were found where the dip was nearly vertical. Where the angle of dip was as small as 60 deg., the lode was usually poor.

The width of the lode averages about 1 m. Smooth wall-rock surfaces are presented, differing from the Maria in this respect. The silver mineralization appears to have been confined to the lode itself. Wherever branches came into the main lode they produced bonanzas. The silver minerals of the Sacramento lode were the green and white varieties of silver chloride, both crystalline and amorphous, and some of it beautifully transparent. Silver sulphide was also found in large quantities. Native silver, iodyrite, bromyerite, proustite, pyrargyrite, stromeyerite, and the double chloride of silver and sodium were found in less amount. The gangue minerals were calcite and chalcocite. No galena was observed. There is much limonite and there are also stains of copper carbonate. No pyrite has been found in the region above the porphyry.

In this lode below the porphyry fairly rich ore, approximately 1,500 oz. per ton, was found, and 52,000 oz. of silver was extracted. For some reason, the work was discontinued. This was at a depth of 340 m., and 135 m. below the present water level. The ores at that point were said to be similar to those from the upper workings, but a sample said to have come from there contained chalcopyrite which was about half altered to chalcocite. Apparently, oxidation had not proceeded as far there as it had in the upper part of the lode.

The Second System Fractures

The veins of the second system strike about N. 80 deg. to 86 deg. E. and dip from 30 deg. to 70 deg. S. They are characterized by flat dips, uniformity in dip and strike, and few irregularities in the surface of fracture. They show vertical displacement along the fracture, but owing to the immense stopes at the intersections of these veins with those of the first system it is impossible to determine by displacement which of the two systems is the older. In describing the Maria lode it was noted that the lode was deflected by the Verde lode, the Verde being a second system vein.

The first series of veins dip to the south at right angles to the stratification. The second system veins cut the lines of stratification at angles from 80 deg. to 45 deg. as shown in Fig. 4. The second system veins seldom carry ores of silver, except at or near their intersections with veins of the first system. They are filled with calcite, contain a greater amount of chalcocite, and are heavily stained with the carbonates of copper. Neither pyrite nor chalcopyrite is found, and limonite strains are more rare. The silver minerals found in these lodes are of the same character as those in the lodes intersected by them.

Considering the character of the second system veins, one is puzzled to account for their lack of silver minerals. In the same rock 30 m. away, the first system vein may be richly productive, whereas the second system vein is barren of silver and considerably richer in copper. If they were previous in formation to the first system veins, could the fissures have already been filled before the period of activity of the silver-bearing solutions? Or is it that the flat dips did not reach the source of the silver solutions in depth? It is suggested that they are older than all the others; at the time of fracturing the strata dipped 20 deg. to 30 deg. to the south, instead of, as now, to the north; the fractures were

never channels for uprising silver solutions; their effect upon the deposition of ore was limited to enlarging the cavities at the intersections with the first system, slowing up circulation at these points, and otherwise aiding the solutions to deposit their metallic content; and the lateral flow of the solutions along the fissures was much restricted.

In one lode, worked by the Spaniards, the bromide and iodide of silver must have been found in considerable amounts, for even today the old stopes give perceptible amounts of bromine and chlorine gases, due to the decomposition of the minerals in the waste and the ore left in the vein. The occurrence of these two silver minerals is chiefly confined to that part of the district now covered by the alluvium. Not far away are the "pampas" containing deposits of sodium nitrate and with the nitrate are found iodine compounds. The occurrence of "huantajayite," or the double chloride of sodium and silver, is unique. This mineral occurs only

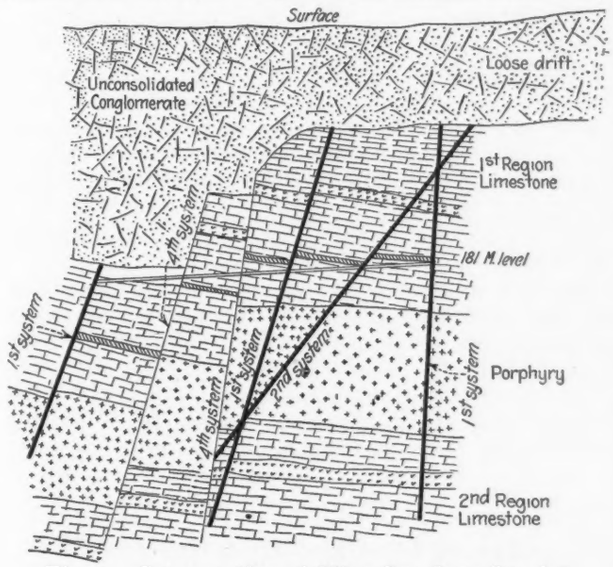


Fig. 4. Cross-section of Mina San Juan Level 5, showing dips of fracture system

as incrustations on the other vein matter, and sometimes in minute fractures in the rock close to the vein. It is plainly secondary, and as the other minerals found are secondary, the huantajayite must be a secondary derivative from them. As this mineral is soluble in cold water, with precipitation of silver chloride, it is rather difficult to account for its origin by the ordinary processes of secondary action. It is interesting to note that F. Corfu produced this mineral artificially by dissolving silver chloride in a strong ammoniacal solution of sodium chlorite, and then evaporating. The proximity of the nitrate fields, with their sodium nitrate and sodium chloride deposits, suggests that a similar process might have produced the huantajayite, the ammonia in some way being derived from the nitrate.

The Third System of Fractures

Following the fracturing which produced the vein fissures there was another set of fault movements which was general throughout the district. This series of faults was formed while the strata were still practically horizontal, and some of them now appear as reversed faults, but originally they were all normal. The faults strike about N. 45 deg. W. and have various dip angles. A good example is a fault striking N. 44 deg. W. and dipping 45 deg. SW. It is believed to have originally dipped about 60 deg. SW. These fractures vary from 2 to 12 in. in width and are filled with calcite, but are barren of silver minerals and have no copper stains. Their economic importance is due to the displacement of the silver veins and to their directing influence upon the downward percolating waters which produced the secondary enrichment. Some of the bonanzas have occurred in the parts of the silver veins above the flat dipping faults.

The Master Fault

In the eastern part of the district the principal mass of porphyry is found about 200 m. lower than in the western section. This is also true of the shell limestone and of the diorite sheets. At the point where the break in the strata occurs, there is a broad broken zone, slightly variable in strike, but with a constant dip of 58 deg. E. This zone of broken material is, in places, 10 m. wide, though often not more than 4 or 5 m. The average width is about 8 m. The side to the east is usually composed of badly broken porphyry. The limestone adjacent to the zone usually presents a calcined appearance. There are one or two layers of red clay several inches thick on the foot-wall side. An old theory regarded this zone as a diorite dike. Another theory was that it was a fault zone. The lodes east and west of the zone cannot be correlated. After allowing for the displacement of 200 m. vertically and considering the fault as a normal fault, it is impossible to fit the lodes together on each side of the fault. Not only are the positions different on each side, but the number is not the same. It is suggested that originally there might have been a diorite dike dipping 45 deg. to the east, and that this dike was formed earlier than any of the known fissures or faults. Then occurred the second, first, and third system fractures, in the order named. The first system fissures, or silver lodes, in propagating in the practically homogeneous country rock, would have encountered the break, and might emerge on the other side at different points, and some might have died out at the break.

After the first three systems of fractures, and even after a large part of the secondary enrichment had taken place, strains were set up which found relief in a 200 m. movement along the old dike. For reasons which it is not germane here to discuss it seems certain that the hanging wall or eastern side subsided, and that the western part remained stationary. This is of course important in considering the secondary mineralization in conjunction with the ground-water level.

The Fourth System of Fractures

As a result of the faulting along the old dike, and contemporaneously with it, a series of faults striking N. 20 deg. to 30 deg. W., and usually dipping to the west, was formed. Being the most recent disturbances, the faults have cut across everything except the master fault, in which they terminate. The eastern part is the only section which shows these faults, but they are numerous there and have large displacements, both vertically and horizontally. A glance at Fig. 1 will show the difficulties presented to exploration by them. These faults invariably have the foot-wall side lower than the hanging, and are therefore reversed as to dip, but are normal as to strike. By solving a few of the fault problems it was concluded that vertical as well as horizontal forces were in play. In the southern part of the eastern section of the district the lodes are sometimes

displaced several meters by movements along bedding planes in the limestone. These were apparently without effect on ore deposition, and are probably local movements resulting from the 200-m. fault along the old dike. In some instances they are displaced by the fourth system faults, but their origin must have been contemporaneous.

Genesis to Primary Deposition

It is most probable that the first system of fissures tapped the source of silver, copper, and iron-bearing solutions in depth. With upward flow, and loss of pressure and temperature as the solutions neared the surface, the metallic sulphides began to be deposited. This probably began in the limestone immediately below the porphyry and continued for a considerable distance beyond the present surface. The porphyry and diorites were not active precipitating agents. The minerals were deposited as pyrite, chalcopyrite, tetrahedrite, polybasite, and other minerals, and the deposition was practically uniform wherever the lodes were in limestone, with perhaps bonanzas at the intersections with the second system fissures.

Subsequent Changes

The relative amounts of the various sulphides originally present would in large measure determine the character of the secondary ore. If pyrite was present originally, in proportion to its amount chalcocite would result as a secondary mineral, provided the chalcocite was not in turn replaced by silver sulphide. Also, if the silver sulphate solutions from above should migrate to a region rich in ferrous sulphate and poor in pyrite and chalcocite, the resulting ore would contain native silver and no copper. Silver sulphate coming from above might find chalcocite the only reducing agent, in which circumstance the silver sulphide would continue to be formed until all the chalcocite had been used up. The resulting copper sulphate might not find a precipitating agent in the vicinity and might move to another locality before being converted to chalcocite. This is conformable with the evidence found today. Wherever the lodes were richest in silver sulphide there was a marked absence of copper stains on the lode and wall rock. Wherever much copper was found, the silver content was usually low.

According to the foregoing reasoning, the big bonanzas were chiefly the result of the action of the primary sulphides upon the silver sulphate brought in solution by downward-percolating waters from the upper leached parts of the lode. It is probable that the ground-water level stood at about the base of the porphyry for a considerable period. During that time a large part of the limestone was eroded and the silver contents of the lodes, in part, were concentrated below. How far the processes of secondary enrichment had proceeded before the 200 m. fault allowed the eastern section to subside, and thus stop concentration below the porphyry, is a question in the solution of which lies the future history of the district.

Monazite Found in Nevada

Examinations for various rare metals recently made at the Rare and Precious Metals Station of the Bureau of Mines, at Reno, Nev., have disclosed remarkably rich specimens of monazite from New Mexico and some high-grade carnotite in gold-silver placer metal from Nevada.

Graphite Crucible Tests of Bureau of Mines

Early in 1918 the Columbus station of the U. S. Bureau of Mines began an investigation of American bond clays and graphites to determine their crucible-making properties in comparison with foreign clays and graphites. Work on the bond clays, which was completed in the fiscal year 1920, showed that better crucibles could be made from domestic clay than from imported clays. The testing of graphites, on which some preliminary work had been done, was then undertaken by the Bureau of Mines. Samples of seven graphites, from Ceylon, Madagascar, Canada, New York, Alaska, Texas, and Montana, of 400 lb. each, were obtained. Then crucibles of No. 70 size were made from each graphite for brass-melting purposes, and six crucibles of No. 60 size for testing under steel-melting practice. These crucibles were made in the plant of the Vesuvius Crucible Co., at Swissvale, Pa. The brass-melting crucibles were shipped to the plant of the Detroit Lubricator Co., at Detroit, Mich., where they were tested under regular brass-melting practice.

Arrangements were made for testing the steel-melting crucibles in the plant of the Simonds Manufacturing Co., at Lockport, N. Y., but when the crucibles were ready for shipment word was received that the pit furnaces of the Simonds steel plant were not in operation, and as they have not been in operation since that time, it has been impossible to test the steel-melting crucibles.

In the brass-melting tests, the average number of heats of the crucibles shown by the different graphites are as follows: Alabama, 13.09; Madagascar, 12.44; Ceylon, 10.50; New York, 9.60; Texas, 6.80; Montana, 6.11; Canadian, 5.80. These results indicate that good brass-melting crucibles can be made from Alabama graphite, and agree with the findings of previous work.

Lack of Transportation Restricts Copper Production of India

Speaking of the metallurgical industries of India, the *Journal of Indian Industries & Labour* for November, 1921, says:

"For many years the existence of a long narrow vein of copper ore running from northwest to southeast across the Dalbhum pargana of the Singhbhum district has been known. Early attempts to work the vein failed, chiefly on account of lack of railway communication. Soon after the building of the main Nagpur line, the old mines at Rakha, just to the east of Jamshedpur, were taken over by the Cape Copper Co., which, after many delays and difficulties, caused chiefly by the Great War, is at last producing refined copper of 99.5 per cent purity and, given adequate supplies of fuel and flux, which owing to the 'wagon shortage' are not forthcoming, could turn out 2,000 tons per annum. Its actual production is near 1,200 tons—a convincing example of the great loss which India suffers from the restricted development of her railways. A second company, called the Cordoba Copper Co., is engaged in exploiting the same vein further to the west, but it will be some time before it is in a position to produce metallic copper.

"No attempt is now being made to refine the chromite and manganese ores occurring in the district, although they are mined and exported or else used as refractory material. Ferromanganese was made by the Bengal Iron Co. during the war at the special request of the government as an emergency measure, but it seems improbable that this industry will ever attain much prosperity, owing to the high average content of phosphorus in Indian coal, which finds its way into the finished product."

The Marketing of Pyrites

Atlantic Seaboard and Southern States Principal Markets—Foreign Pyrites Favored by Low Ocean Rates and Large Deposits Contiguous to Huelva, Spain —Competition Mainly Between Domestic and Foreign Pyrites and Brimstone

BY GEORGE J. YOUNG
Western Editor, *Engineering and Mining Journal-Press*

PYRITES is a trade name applied to commercially valuable pyrite, marcasite, and pyrrhotite, together with accessory sulphide and other minerals in greater or less amount. Pyrrhotite is relatively unimportant. The marketing of pyrites, and particularly of foreign pyrites, upon the Atlantic seaboard is due to the presence of large, cheaply mined deposits of pyrites of an unusual grade in the Rio Tinto region of Spain and the comparatively low ocean transportation rates that prevail between Huelva, Spain, and the Atlantic seaboard of the United States. Both domestic and Canadian pyrites are sold in the eastern markets of the United States, but as the bulk of the transactions are in Spanish pyrites, the conditions under which this is sold and purchased may be assumed to be typical of the commercial practice.

PYRITES OF WIDE COMMERCIAL APPLICATION

Pyrites in a comparatively pure state is one of the raw materials of the sulphuric-acid manufacturer. Brimstone or sulphur is the important competing mineral, although considerable sulphuric acid is manufactured from the sulphur dioxide resulting from the roasting of various metalliferous concentrates high in sulphur. Sulphuric acid is used in the chemical industries, in the manufacture of fertilizers, in petroleum refining, and in the steel industry. Pyrites is used principally in the manufacture of sulphuric acid for the fertilizer trade, although where acid plants are equipped for the purification of the acid the resulting product can be used in any industry.

Consumption of pyrites is restricted to those localities which either by proximity to deposits or by reason of low transportation charges can secure pyrites at a lower cost than a commercially equivalent amount of sulphur in the form of brimstone. As only about 50 per cent of the pyrites is sulphur, there is involved the transportation of a relatively large bulk and the handling of a residue equal in weight to about 75 per cent of the original pyrites. Thus, the important consuming localities for foreign pyrites are situated on or close to the Atlantic seaboard. The centers of sulphuric-acid manufacture in the Atlantic seaboard and Gulf States are as follows, the seaports being on the left and the inland centers on the right:

Massachusetts	
Boston	Lowell
Connecticut	
Fairfield	Naugatuck
New York	
New York	Buffalo
New Jersey	
Chrome	Carteret
Bayonne	
Newark	
Virginia	
Alexandria	Richmond
Norfolk	Roanoke
	Staunton
	Lynchburg
	Petersburg
	Pulaski
North Carolina	
Wilmington	Raleigh
Newbern	Charlotte
	Winston-Salem
	Salisbury
Louisiana	
New Orleans	Shreveport
Pennsylvania	
Philadelphia	Bradford
Marcushook	Pittsburgh
	Warren
	York
	Lancaster
Georgia	
Savannah	Atlanta
	Macon
	Carrollton
	Social Circle
	Pelham
	Lagrange
	Newman
	Rome
	Blackshear
	Athens
	Valdosta
	Columbus
	Augusta
	Albany
South Carolina	
Charleston	Columbia
	Blacksburg
	Greenville
	Anderson
Delaware	
Wilmington	
Florida	
Pensacola	Dunnellen
Jacksonville	Sanford
Alabama	
Mobile	Selma
	Gadsden
	Bessemer
	Birmingham
	Gainsville
	Upelika
	Grasselli
	Dolhan
	Talladega
	Troy

Of the interior states contiguous to the Great Lakes the following are the centers of sulphuric-acid manufacture: Ohio: Cincinnati, Cleveland, and Columbus. Indiana: Indianapolis. Michigan: Marquette and Detroit. Illinois: Chicago and Springfield. Missouri: St. Louis. A small amount of pyrites is consumed in the San Francisco Bay region of California and is supplied from Shasta County.

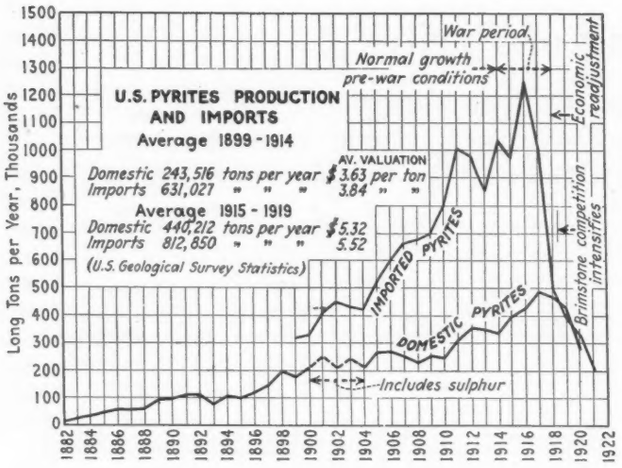
The chief marketing point is New York. There are subagents in important consuming points. Locally produced pyrites is usually sold under long-continued contracts and there is comparatively little competition under such conditions.

PEAK CONSUMPTION DURING WAR PERIOD

Previous to 1918, the annual consumption of imported pyrites, for the most part Spanish, was approximately 1,000,000 tons. Owing to the disturbance in business trends resulting from the war and the intensive development of brimstone deposits in the Gulf region, the market for foreign pyrites has greatly diminished, and its potential capacity will be unknown until equilibrium between brimstone and pyrites is established.

According to the U. S. Geological Survey statistics, the average annual consumption of domestic pyrites for the period 1899-1914, inclusive, was 243,516 tons, of an average value of $3.63; imported pyrites for the same period, 631,027 tons of an average value of $3.84 per ton. For the period 1915-1919, inclusive, the average annual consumption of domestic pyrites was 440,212 tons, of a value of $5.32 per ton; of imported pyrites, 812,850 tons of a value of $5.52 per ton. In 1920, domestic pyrites had fallen to 275,000 tons and foreign pyrites to 332,606 tons. In 1921, foreign pyrites had receded to practically 200,000 tons, of a value of $3.87 per ton. Figures for 1921 domestic pyrites are not yet available. Industrial depression, economic readjustment, and competition from domestic brimstone are the causes of the slump in consumption.

There is no well-marked seasonal demand for pyrites, but buyers of foreign pyrites do not especially want to



Production and imports of pyrites

take large quantities in the early spring or fall. Usually, sufficient stocks are carried which enable the acid producers to meet fluctuations in demand for acid without going into the market for prompt deliveries.

Pure pyrites contains 53.3 per cent sulphur and 46.7 per cent iron. The nearest quality to this theoretical purity is Spanish pyrites. Two analyses are given in the following table:

ANALYSES OF SPANISH HIGH-GRADE PYRITES

	Per Cent	Per Cent
Iron	44.00	43.07
Silica	0.64	6.06
Antimony	0.08	....
Arsenic	0.45	0.05
Lead	1.08	Trace
Bismuth	0.005	....
Zinc	1.70	0.12
Nickel	Trace	....
Cobalt	Trace	....
Selenium	0.08	....
Manganese	0.07	....
Organic matter	0.37	....
Copper	0.70	0.85
Lime	....	0.06
Sulphur	50.00	49.00
	99.175	99.75

THEORETICAL PERCENTAGES OF SULPHUR AND IRON

Pyrite, Per Cent	Sulphur, Per Cent	Iron, Per Cent	Units of Ferric Oxide in Cinder	Units of Ferric Oxide Plus Impurities	Percentage of Iron in Cinder
100	53.3	46.7	66.68	66.68	70
90	48.0	42.0	60.02	70.02	60
80	42.6	37.4	53.35	73.35	51

The impurities usually present in relatively small amounts are insoluble (including silica), zinc, lead, antimony, arsenic, and copper. Zinc and lead, when percentages approximate 3 per cent or over, are objectionable, as their presence increases the amount of sulphur retained by the cinder or residue. Arsenic is objectionable for some acids, particularly those used in the chemical industries, but is not objectionable where the acid is purified or is used without purification, as in the manufacture of fertilizers. All Spanish pyrites contains more or less arsenic, but this has not restricted its use except as noted. Arsenic much in excess of 1 per cent would, however, be objectionable, although there does not appear to be a clearly defined upper limit recognized. Pyrites contaminated with a large percentage of impurities is practically unsalable.

Physical Requirements of Pyrites

Two kinds of pyrites are recognized upon the market, "furnace ore," or lump, and fines. Lump ore ranges in size from 2 to 10 in., and the proportion of fines must not exceed 10 per cent past a $\frac{1}{2}$- or $\frac{3}{8}$-in. screen. All material past a $\frac{1}{2}$- or $\frac{3}{8}$-in. screen is sold as "fines," the price differential being usually 2c. per sulphur unit less than for lump ore. Sometimes the "ore" is sold as run-of-mine, but this kind is objectionable, as it usually carries a large proportion of fines. Should the furnace or lump ore contain a greater percentage of fines than the 10 per cent maximum, the allowances to be made would be subject to negotiation. The same would apply to the fines if there were any pieces that failed to pass the limit screen size.

Pyrites is usually shipped in cargo lots of 3,000 to 6,000 tons, and is bought and sold in lots of 500 to 1,000 tons, up to a cargo. Domestic pyrites is handled in carload lots and on a contract basis in which the quantities may vary between wide limits. The allowable tolerance in weight on shipments is 10 per cent over or under the specified weight.

No well-defined premiums or penalties are recognized, but where transactions involve uncertainty, special clauses are inserted in the sales contract covering them. An increase in the price is usually allowed where sulphur exceeds the guarantee basis and a penalty where the sulphur content is less. No allowance is made for moisture except where it is in excess of 1 per cent.

Sampling is usually done by a disinterested chemist who acts for both buyer and seller, sampling the cargo as it is discharged from the steamer and analyzing the sample. His results are generally final and binding on both parties. The expense for sampling and analysis is divided between buyer and seller. In some transactions both buyer and seller have their agents present, and the sample is divided and sent to separate chemists, the price of the ore being figured on the mean of the separate returns.

Shipment and Delivery Conditions

Pyrites is always shipped in bulk and frequently foreign pyrites is shipped as ballast. Shipments are usually c.i.f. (cost, insurance, and freight) and delivery is made from the "ship's tackle." Occasionally, contracts are made on an f. a. s. (free alongside ship) basis, and under this designation the consignee takes the ore out of the steamer after the ship has been placed alongside the pier. Cargoes are often distributed among several different consumers, each taking from 500 to 1,000 tons. This makes it easier for the seller to finance the sale and avoids a loss due to the interest on his purchase. Although buyers do not especially care to take large quantities of pyrites during the early spring or fall, no cut in price on deliveries is made at these times.

The value is computed on the percentage of sulphur in the ore at the contract price per unit on the basis of the long ton, 2,240 lb. Thus the unit is 22.4 lb. sulphur. The usual terms of settlement are ocean freight, cash, on arrival of vessel, and the balance of the invoice due on the 10th of the succeeding month.

Price Range Limited

The price of pyrites ranges from 12 to 14c. per unit, the differential between furnace ore and fines being usually 2c. per unit. This price is for high-grade Spanish pyrites, and the quality must be good. The price is equivalent to $0.00535 per lb. of contained sulphur, or $12 per 2,240 lb. of contained sulphur, up to $0.00625 per lb. of contained sulphur, or $14 per 2,240

lb. of contained sulphur. Before the war, prices were approximately 13c. per unit for furnace-size ore and less for fines and run-of-mine. During the war prices reached 30c. per unit, taking into account the excess ocean freight which had to be paid on account of scarcity of tonnage.

Spanish pyrites dominates in the domestic market except in certain localities, principally because the domestic ores are lower in grade, running between 35 and 40 per cent sulphur; the imported ore runs to 50 and 51 per cent.

As a rule, the buyers retain the cinder, but this custom will probably be discontinued and the cinder resulting from the burning of the pyrites will be returned to the sellers. The cinder is desulphurized and sintered and sold as iron ore at a rate of 12c. per unit (long ton) of contained iron. In some instances where the percentage of copper is high enough, the cinder is leached first and then disposed of as an exceptionally pure iron ore after being desulphurized and sintered.

Suggested Form of Contract

An example of a form of sales contract is as follows:

Quantity and Description—Concluded this . . . . . day of . . . . . between the . . . . . seller . . . . . , who agrees to sell and . . . . . buyer . . . . . , who agrees to purchase the sulphur contents in about . . . . . tons, 10 per cent, more or less, seller's option, of . . . . . on the following terms, viz.:

Shipment—Shipment to be made from abroad . . . . . Seller to have the right to anticipate deliveries, but the buyer, by reason of such anticipation of deliveries, shall not be required to have on hand at any time more than . . . . . tons.

Delivery—Delivery to be made ex-ship . . . . . buyer guaranteeing sufficient water at mean low tide at safe wharf where vessel discharges, vessel always afloat.

Buyer agrees to take delivery of ore as fast as discharged from vessel per day of twenty-four hours as required by seller, and to provide lighters, railroad cars, or other means of transportation so that discharging will not be impeded.

Price—The price to be . . . . . per unit of sulphur, per ton of ore of 2,240 lb., on dry basis, no allowance to be made for moisture unless in excess of 1 per cent. Certificates of weight and analysis to accompany each invoice.

Terms—Payment to be made in gold or its equivalent, in New York funds, on the 10th of the month for all ores delivered the previous calendar month.

All ocean freights to be paid by buyer and deducted from invoice, with the exception that gross ocean freights in excess of . . . . . shall be borne by buyer. Should the buyer fail to pay his invoices at maturity, seller to have the right to cancel the unfulfilled portion of this contract by giving buyer written notice.

Analysis—The ore shall be sampled ex-ship at port of discharge and tested for sulphur by . . . . . such determination to be final and binding upon both buyer and seller. The cost of sampling and analysis to be borne half each by buyer and seller.

Weight—The weight to be ex-ship at port of discharge according to the certificate of sworn public weigher, whose certificate shall be accepted as final by both buyer and seller.

Place of Consumption—The above ore is for consumption only at the buyer's works at . . . . . .

Cinder—The cinder from said ore, after burning, shall be the property of buyer (or otherwise as especially agreed).

General—In the event of fire, strikes, lock-outs, combinations of working people, scarcity of miners or other workmen, stoppage of mines, trains, or damage or accident to machinery, mines workings, piers, railroad or warehouse, illegal or excessive charges by those operating the mines, wars, civil commotion, epidemics, intervention by constituted authorities, whether civil, military, custom or sanitary; stress of weather, lack of berth room, inability to charter vessel, or any other cause or causes whatsoever occurring at the mines, port of loading, or of discharge or elsewhere, beyond the control of the seller or buyer, by reason of which shipments or deliveries of ore are retarded, delayed, interrupted, or rendered impossible, the seller shall not be liable for failure to make shipments and deliveries, and the time allowed for any stated shipment or delivery under this contract shall be proportionately extended for the period of two months beyond the stipulated time therefor; but, however, if by reason of any cause or causes arising under this clause, deliveries of ore shall be interrupted for more than two months beyond the stipulated time therefor, then the seller shall have the right to cancel this contract.

It shall be optional with the seller as to whether or not he shall replace shipments lost at sea, but he shall not be liable for any damage on account of non-arrival of such shipments lost at sea.

In no event shall shipments under this contract be extended beyond . . . . . .

Buyer shall pay all customs duties and imposts, if any, charged upon said ore by the United States or Spain.

Should any dispute arise as to any of the conditions of this contract, the matter is to be referred to the arbitration of two disinterested persons, one each to be chosen by buyer and seller respectively, and if they should fail to come to an agreement, they shall appoint a referee, whose decision shall be final.

If either party shall fail to appoint an arbitrator within twenty-one days after notice in writing requiring him so to do, the arbitrator named by the other party may act as sole arbitrator.

Acknowledgment is made of the material assistance of C. B. Stranahan in the preparation of this article.

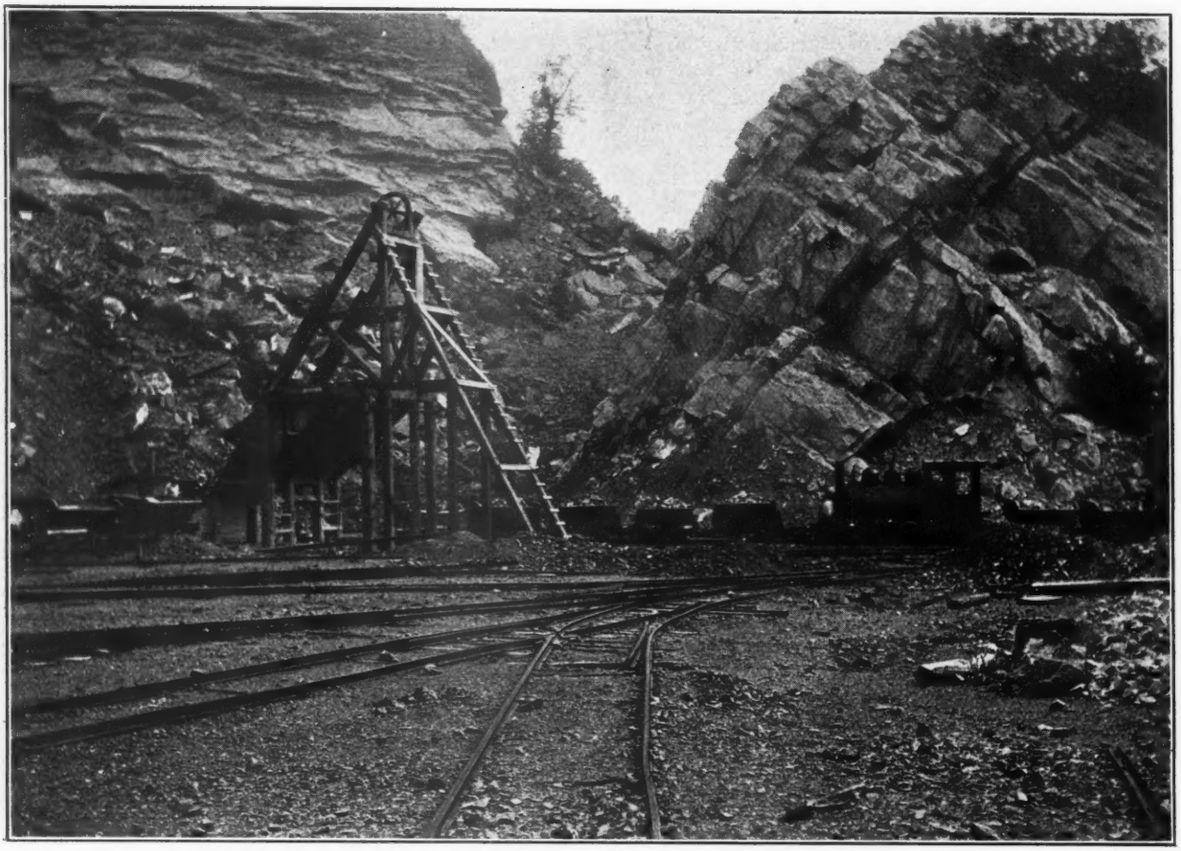
Canadian Feldspar in Demand

The production of feldspar in Canada in 1921, though somewhat below that of recent years, was still creditable, the tonnage mined amounting to 33,597, according to the Canadian Department of Mines. During the period slightly more than 2,000 tons was milled. Shipments, all from Ontario and Quebec, totaled 30,540 tons, valued at $223,000, an average of $7.31 a ton. Of this quantity all but 200 tons was sold in the crude form. Two-thirds of the crude feldspar sold came from Ontario deposits.

Complete returns were received from the six operators in Quebec and from fifteen producers in Ontario in 1921.

Imports of feldspar during 1921 were valued at $25,120, and exports in the same period totaled $169,864 in value. The quantity of feldspar exported reached a total of 27,292 tons. Imports amounted to only 1,050 tons.

Canadian feldspar has been in considerable demand in the United States in recent years, and the erection of further grinding plants in Canada will permit of the export of Canadian feldspar at a much higher price than is now obtainable for the crude product. One new grinding plant has been opened during the last year, and Canadian producers are apparently fully alive to the desirability of preparing the Canadian product in its most valuable marketable form.



Sinking headframe at No. 3 quarry of American Lime & Stone Co.

Shaft Sinking in a Limestone Quarry

Underground Mining Methods Are Being Used To Procure High-Grade Limestone Instead of the Customary Quarrying—A Four-Compartment Inclined Shaft Sunk and Other Work Done on Contract, Preparatory to Installation of Mining Machinery

By J. H. Stovel

THE RECENTLY COMPLETED SHAFT at the No. 3 quarry of the American Lime & Stone Co., of Tyrone, Pa., presents an interesting development in the mining of limestone. The company has for many years operated quarries and lime kilns in the vicinity of Bellefonte and Tyrone, and about two years ago started work on the erection of a large lime-burning and hydrating plant. This plant involved a considerable outlay of capital, and to secure the product which would give the fullest returns on the investment it was necessary to have a constant source of supply of high-grade limestone.

The company has, in its quarries around Bellefonte, a 75-ft. ledge of limestone, known locally as the "good stone," which met fully its requirements as to quality. Unfortunately, the limestone measures at this point dip into the hills at a 52-deg. inclination, which fact makes it difficult at times to quarry this special ledge without getting a large amount of the lower-grade surrounding limestones mixed in with the "good stone." For this reason the company decided to make use of underground methods as the only economical means of assuring a constant output of limestone of the required quality. The development work, involving a shaft, pocket, raise, and crosscuts, was done, under contract, by the E. J. Longyear Co., of Minneapolis, Minn., according to specifications prepared by A. Neustaedter, mining engineer for the American Lime & Stone Co.

No Need to Support Hanging Wall in Shaft

The accompanying diagram shows the underground work. The shaft was sunk in limestone in the floor of the quarry about eighty feet from the foot wall of the "good stone" ledge. It is 8 x 24 ft., has four compartments, provision being made for two skipways, one cageway, and one ladder, and is 391 ft. deep on the inclination. The shaft was sunk in a stratum of limestone 8 ft. thick, so that advantage could be taken of the slips in drilling and blasting. This provided an unbroken slip for the shaft hanging wall and, judging from present appearances, the shaft will never need any timbers for the support of the hanging wall. The inclination of the measures changed gradually from 52 deg. at the surface to 63 deg. at the bottom of the shaft, but, as the stratum of limestone maintained its thickness, the shaft was allowed to follow the measures.

The shaft is concreted at the collar for about twenty feet and has some special timbering at the pocket.

Between these points the only timbering consists of a row of 8-in. posts carrying a 2-in. plank partition between the inner skipway and the cageway. A 250-ton storage pocket connects the lower crosscut with the shaft, and this pocket is connected with the upper crosscuts by a raise with bypasses to the crosscut, so that all the stone is handled from the one pocket. The stone in the pocket will be fed, by compressed-air-actuated revolving drums, into measuring pockets, which will in turn discharge into five-ton skips. The first crosscut was driven 70 ft. vertically below the quarry floor, and the other crosscuts at vertical intervals of 60 ft. The crosscuts are 7½ x 24 ft. and extend from the shaft to a slip, in the "good stone" ledge, which is to form the hanging wall of the stopes.

Underhand Stoping To Be Practiced

The section through the stopes, shown in the diagram, indicates the proposed method of mining. The ground above the crosscuts will be left as a pillar, and a stope, which will be 30 ft. high vertically, will be opened up on each side of the crosscut. After the preliminary opening has been excavated it is planned to carry a pilot drift at the top of each stope. The upper cut will be slashed across the stope from this pilot drift and the two remaining cuts will be taken out as underhand benches. Mechanical shovels will be used to load the stone from the stopes into the mine cars. As the stopes will have plenty of head-room, and as the material to be handled will be fairly coarse, a heavy type of underground shovel will be used. The crosscuts will be cut higher at the hanging-wall end, so that one shovel may serve either stope on the same level.

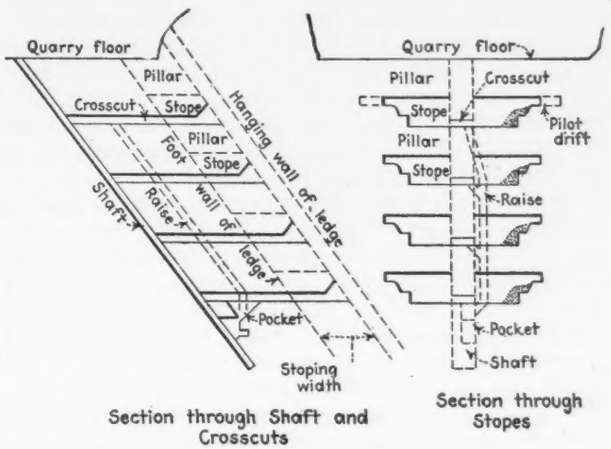
Electric motors will take the cars from the shovel to the raise or pocket. The ground between the floor of one stope and the roof of the stope next below will be left as a temporary pillar, and permanent pillars, extending across the width of the ledge, will be left at regular intervals. When the stopes have been mined to the desired distance from the crosscuts, the greater part of the temporary pillars, referred to above, will be mined by a retreating method. The hanging wall of the stopes will be formed by a well-defined slip in the ledge which is about 15 ft. from the real hanging wall. This will give a stoping width of about 60 ft. The company expects to produce from 1,000 to 2,000 tons per day from the shaft.

Crushing and Grinding

The sinking headframe, shown on the opposite page, will be replaced by a steel headframe and bins. The "good stone" ledge shows in this photograph just back of the headframe sheave wheel, and the dip of the measures is also shown clearly. The stone will be drawn from the headframe bins into cars, which will be hauled a short distance and dumped into the crusher. An elevating conveyor belt will take the crushed stone to storage bins. From these bins it will pass to a large rotary kiln and thence to the hydrating plant. A tube mill is provided for use when fine grinding of the stone is desired. The process used in the hydrating plant, which is already in operation, differs considerably from the usual method of manufacture, and the system, together with the adoption of underground mining, has been the source of considerable interest to other limestone producers and lime manufacturers.

Stations were cut at each crosscut as the shaft was sunk, and, on the completion of the shaft, a raise was driven, through the section of the pocket, from the shaft to the lower crosscut. A timber chute was built at the bottom of this raise, and all the stone was loaded from this chute directly into the one-ton skip which had previously been used in mucking during the sinking of the shaft. The crew was then divided, one gang driving the raise to connect the pocket with the upper crosscuts while the other gang drove the crosscuts forward to the point where the raise intersected them. When the raise was finished, muckers were hired and the shaftmen who remained were employed on drilling only, each crew having two crosscut faces to work to. All the stone from the raise and from the greater part of the crosscuts was handled through the chute in the pocket raise. On the completion of the crosscuts, the pocket was stripped to the full section required, and a pump station cut in the end of the shaft at the level of the bottom of the pocket. The laying of the permanent track ties completed the agreement undertaken by the contracting company.

No. 55 Clipper drills were used in the shaft, and these were mounted and equipped with water heads for



General underground arrangement, shaft of American Lime & Stone Co., Bellefonte, Pa.

the work in the crosscuts. A shift boss and five miners were employed on each eight-hour shift in the shaft and a progress of 5.4 ft. per day was made. Though the progress made, as expressed in feet per day, was not extraordinary, a consideration of the size of the shaft and of the number of men employed will indicate that the headway made was decidedly good, as 1.01 tons was mucked per man-hour and 6.6 ft. was drilled per machine-hour. The time record of the shaft work was as follows: Drilling, 16 per cent; blasting, 8 per cent; blowing smoke, 7 per cent; mucking, 56 per cent; miscellaneous (such as track, pipe, and timbering brow at crosscuts), 12 per cent, and delays, attributable to various causes, 1 per cent.

The costs, per cubic yard, of the shaft and station work, exclusive of the contractor's profit, were as follows: Labor and bonus, $4.81; power (electric), $0.54; explosives, $0.61; materials, $0.30; buildings and equipment, $0.69; a total of $6.95. Shift bosses were paid $5.50 per shift; miners, $5; blacksmith, $5; hoistmen, $3.50, and surface labor, $3. The bonus paid was on a sliding scale, depending on the progress made. The costs given above do not include amounts paid for timbering materials nor the labor that was charged to the operation of the compressor.

Canada as a Gold Producer

Prophecies Injudicious—Porcupine Mines Preparing for Greater Production—Better Conditions Will Result in Growth in Number Of Smaller Operators—Elbow Lake and Other Districts Promising

By Alexander Gray

WITHOUT WISHING to be disputatious I must take friendly exception to the view expressed in the Annual Progress Number of the *Engineering and Mining Journal* that a decrease in the Canadian production of gold is "inevitable," because "the producing mines are reaching increasing depth, and no new large ones are being opened."

Twelve years ago, almost every mining engineer of more or less eminence—Canadians included—dogmatically declined to believe Canada would or could present a gold field or fields of first magnitude. The highest authorities, off-hand, or after inspection, flouted the geology, mineralogy, and fissuring. "Bull" quartz in schist, lenticular features, were accentuated to the point of rejection. American mine owners operating at Cobalt were given to understand that Porcupine did not possess the essential attributes; the opinion was registered that the Dome property "never will make a mine"; that the combined Hollinger areas would not reimburse their owners for purchase moneys, equipment at a nominal price, and development capital.

Time and again the McIntyre property was unceremoniously condemned. And I myself, after having had access to the Dome assay plans, and discounting the average owing to the method of sampling adopted, was classified as a falsifier. Hollinger principals were accused of high-grading their initial test shipment, and it was urged that the orebodies at the outcrop lacked lateral and, presumably, vertical continuity. Repeated efforts to interest mining capitalists in the McIntyre were unsuccessful.

Increased Capacity Planned at Porcupine

As the Hollinger, Dome and McIntyre companies are to be credited with most of the increased and total production of gold in Canada, it is admitted that they are mining at depths where the "inevitable" is nearer. That admission, however, conveys no element of apprehension, any more than is it a reasonable deduction that "no new large" mines will be "opened," either in northern Ontario, or throughout the west and northwest, where recent discoveries provide preliminary evidence of extensive gold occurrences.

No one familiar with the Ontario districts in particular will hazard projections as to depths and values beyond the known and positively indicated. By diamond drill and workings the lives of at least the three mines specified are assured for a period during which further explorations will be undertaken. Increased milling capacity, planned without trepidation, bespeaks the confidence of the respective managements; consequently, deeper development is to be expedited.

It follows that for the time being the gold output will increase and that for some years the three companies named will contribute annually as much gold as the whole of Canada has been doing of late. To doubt this is to confess ignorance of the mining position and substantiated outlook. Provided there are no interruptions, the current year will give the Hollinger mines the world's milling record, if labor and power are adequate, without encroaching upon the estimated ore reserves.

A comprehensive mining program for the upper sections, and the inducements disclosed in the lower levels, cast no shadows. In reality, the Hollinger's milling capacity must be enlarged—and doubtless the grade will be lowered—owing to large stoping widths, where glory-holing is now being considered. How to deal with intimately related orebodies and great lower-grade sections which dictate milling expansion has given the management more concern than the likelihood of disappointments at immediate depth.

For the sake of argument, were argument intended, it will be conceded that the Hollinger is pre-eminent. Its capitalization exacts rapid production and redemption of capital. Dome Mines is second in importance. Whereas Hollinger workings at 1,200 and 1,550 ft. denote no change of formation, development below the 800 level has been more incidental than progressive, centralization being necessary until labor was more plentiful and efficient. It might be a slight error of underestimation to place Hollinger ore reserves above the 1,000 level somewhat in excess of the total tonnage extracted to date, or about 5,000,000.

For the Dome Mines, no recent estimates of ore reserves were incorporated in the annual reports. It is known, however, that the values are more consistent at the 1,000 level and that there is better definition. This is reflected in the milling grade and in the decision of the directorate to proceed with the redemption of capital at the rate of $1 a year, besides the customary quarterly distributions. Hence the expectation that the output will be maintained if not increased. And what applies to the Dome properties is not to be denied to the McIntyre mines, where mining is being done at the 1,800 level.

Number of Producing Properties Will Increase

According to Witwatersrand standards, the three mines named may be regarded as the only large or nearly large ones. Here is where relativity of the smaller mines to the aggregate output now and hereafter enters into this discussion. Without recourse to probabilities contained in areas adjacent to the Hollinger, McIntyre, and Dome, where drilling and development have induced Nipissing and other companies to bestir themselves, it is possible that no "new large" mines within the meaning of the writer in the Annual Progress Number may be in the developing stage elsewhere at Porcupine; but there will be more producing properties a year from now than there have been since the war intervened. Working capital was unobtainable by some of those equipped for crushing. While producing companies were crippled, it was impossible for others to do development, because of lack of capital. It is unnecessary to file a detailed bill of particulars, for those fully informed are confident of progressive outputting, irrespective of the factor of "inevitability" in mining.

Unmindful of what happened in the American West,

where it was the multiplicity of smaller mines that gave impetus to all mineral industries, the tendency among outstanding engineers is to discard others than the "new large"; just as Canadian bases of capitalization take those of Cobalt for example. Notwithstanding Cobalt precedents and Rand gages of what a mine should be to interest combinations of capital, the conviction prevails that the widespread distribution of gold throughout northern Ontario will afford enough meritorious properties to broaden the movement throughout the district.

Corroboration of the conclusion above set forth has been forthcoming from the so-called Kirkland Lake district, where values at depth are greater. The accumulative effect of six producers at Kirkland Lake by no means is a deterrent. Lake Shore and Wright-Hargreaves would be large mines in other districts of North America. The former is developing 5-oz. rock—much above the milling average—in its deepest workings, and the latter has the greatest milling capacity in the locality.

Adjoining on the east, the Tough-Oakes, Burnside, and Sylvanite, in co-operation, have solved problems of faulting and are to augment the provincial gold output. To the west, the Teck-Hughes and Kirkland have been joined by the Ontario-Kirkland, situated to the south—and all three are in the outputting sheet—without inviting invidious comparison with their neighbors or the Hollinger, Dome, and McIntyre.

Kirkland Lake has been slower to reach maturity. Its half dozen productive companies exceed in number those of the larger Porcupines, and there will be other Kirklands when venders offer more attractive terms to those capable of providing capital. They are not going to be Homestakes or Hollingers. Withal, as an experienced engineer, formerly chief of staff to one of the Witwatersrand groups, remarked: "Kirkland Lake and the generality of the northern Ontario country, where the prerequisite geology is favorable, is the most inviting gold field I know of."

In so expressing his opinion, this engineer is a stickler for terms upon properties which have to be proved. Not every area has the "come-back" of the Tough-Oakes, where the human factor accentuated faultings, now being circumnavigated. And the London geologist who brought this about, after inspection of the Porcupine mines, with his added intimate knowledge of Kirkland Lake, declared he had no misgivings as to the future of the districts. Perhaps, in this connection, the most pressing need of the districts here discussed is the amalgamation of eligible areas or saner financing for individual properties.

Improved Conditions Will Bring New Products

"Time is the essence" of all estimates of the future gold production of Canada. Cheap hydro-electric power is indispensable to those who would hasten development. Costs have been prohibitive and capital has been shy. Customs smelters to which gold ore could be shipped have not yet been provided in Ontario. Bonding and leasing on a royalty basis is unknown there outside of Cobalt. Preference among prospectors and promoters has been shown for "market deals"—which often have meant the undoing of all concerned.

Unmindful of what it has entailed to give Ontario a gold production at the rate of over $20,000,000 per annum, it has taken ten years for prospectors, however much they are entitled to consideration, to learn the lesson that Cobalt alone was enabled to provide ample working capital from first shipments of bonanza ore. The idea of raising capital by the lithographed route has been more of a hindrance than helpful—too much to repent of being left on the hands of the public. All of which does not preclude the constructive development of what are excellent prospects. Kirkland Lake and environs especially require thorough exploration, the experience being that values improved with depth—the depth thus far reached.

Elbow Lake and Other Districts Offer Hope

With the information derived from the Porcupine and Kirkland districts, it is not improbable that abandoned properties in the Rainy River and Lake of the Woods sections of Ontario will be reopened. It was the disappointments due to those properties, several of which are equipped with milling plants, and the premature over-booming of Rossland, that deterred Canadian men of affairs from entertaining the newer Ontario gold fields, as well as the Cobalt and Montreal River silver districts. Makeshift metallurgy—chlorination and what not—together with inefficient management in most instances—gave "the dog a bad name." Of late, in the vicinity of Goudreau, outcropping conditions of interest have been noted. But it is at Elbow Lake that results from the Hollinger, Dome, and McIntyre mills are reechoing, and there optimism is rampant.

The influence of one mine like the Hollinger is far-reaching. With its shares of the par value of $5 representing a split-up of four for one, selling on a basis of almost $34, after paying $16,500,000 on the $3,000,000 initial capital of the Hollinger company prior to the merger, with ore reserves valued in the gross at 50 per cent more than the issued capital of the Consolidated, it is not surprising that "every prospect pleases." By taking an exploratory interest in the northern Manitoba Elbow Lake country, individual Hollinger directors set the pace, blazed the trail for those who have blanketed acreage, and may not have more than snow.

As the *Engineering and Mining Journal* stated, Elbow Lake is now in the limelight. Its surface showings make inconsequential their distance from transportation. What may be defined as the Hollinger interest—although the Hollinger company has simply loaned its technical co-operation—is cutting a sixty-mile road from rail, has established camps, provided preliminary equipment and purposes applying acid tests to the wide mineralized zone in which free gold wherever there is quartz may make a "new large" low-grade mine.

Specimens from the property would grace cabinets. Whether the enrichments will carry the larger body of lean rock is what the holders of the option will try to ascertain by early spring or summer. Meanwhile, other discoveries in narrower orebodies are reported.

Anyhow, the countryside is staked, and it is injudicious to prophesy for or against Canada as a source of increasing or decreasing gold supply. Enough finds have been made to please pioneer adventurers, in which respect northern Manitoba has had quicker action than did the Portland Canal district of British Columbia, where the Guggenheims have an interest in a "new large" mine, mostly silver, the gold values not being despicable, however. The Premier mine, as it is known, has increased the precious-metal output of British Columbia and contributed largely toward greater confidence in the district, doubted for ten years and discarded by influential New York mining capitalists.

Lead Losses in Smelting Low-Grade Material

Smelters in Continental Europe Forced To Treat Undesirable Slags and Byproducts During the Great War—Losses Were Higher Than Expected, Being 24 Per Cent for a Serbian Slag Containing 8.5 Per Cent Lead

By Dr. C. Offerhaus
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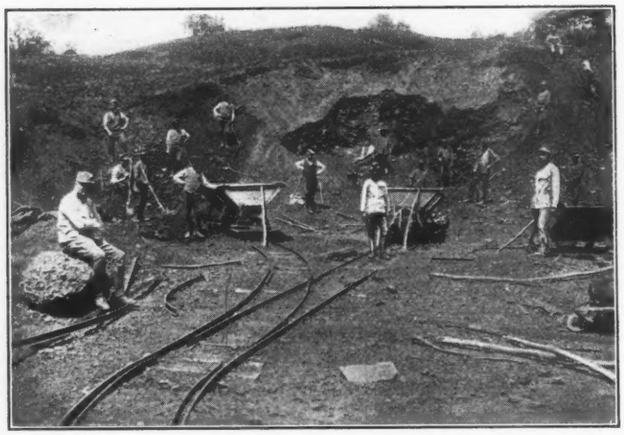
IN SMELTING lead-bearing material, there are losses in the slag, through the stack, and by dust blown away and lead sticking to shoes and cloth. In smelting Australian concentrates and similar European concentrates, as did most of the European lead-smelting works before the war, with rich charges and with only a fairly good equipment for condensation (no baghouse or wet condensation), a total lead loss of about 5 per cent was considered good practice. This figure is based on the dry analysis, according to which the ore was generally purchased.

During the war, the Continental lead-smelting works were obliged to smelt poor materials like muffle residues, rich slags, mattes, and impure, low-grade concentrates. Though one can figure theoretically how much lead goes into the slag with such poor charges, the managements of several lead smelters were not fully aware of the total losses which occurred under these new conditions. Some works undertook to smelt rich Serbian lead slag, with, on the average, 8.5 per cent lead (wet estimation), on which they estimated that a loss of 10 per cent would occur. This allowance had to be augmented first to 15 per cent, and later to 24 per cent. Higher losses than were expected, had, of course, to be covered by lead out of their own concentrates, so that these smelters had to pay dearly for smelting this rich slag.



Old Roman slag dump in Babai, Serbia

Tests Conducted to Determine Losses

To get an exact idea about the total losses which occur in smelting poor lead-containing materials, the management of a lead smelter in Germany kept an accurate account of the total lead charged and recovered when smelting low-grade material. This was continued over several weeks, in periods of one week, not only to find out how large the lead losses really were, but also how they were divided and how they agreed with those calculated.

The estimations which follow, and deductions therefrom, may be of interest to lead smelters which treat mainly low-grade lead materials containing the precious metals, such as silver-containing muffle residues; and to those which treat mainly dry gold and silver ores, and generally experience a lack of lead ores. It should, however, be pointed out, that only lead losses will be discussed, and not losses in gold and silver.

The blast-furnace plant of the smelter which provided the data, and its mode of operation, will be briefly described, so that the reader may better understand the results obtained.

Description of Smelter Equipment

The lead plant has two open-top blast furnaces; the one which was in operation when the tests were made measures 1.07 x 3.5 m. (42 x 138 in.) at the tuyères, and has eight tuyères, with a diameter of 100 mm. (4 in.), on each side. The distance from the tuyères to the charging floor is 6.71 m. (22 ft.), and to the lower rim of the downtake, 5.173 m. (17 ft.). The furnace has one tier of cast-steel water jackets; at both long sides an Arents tap and at both short sides a slag tap hole. The gases are taken off below the charging floor at one of the short sides of the furnace by an unlined square flue, 1,400 x 1,820 mm. (55 x 72 in.) made of 12-mm. (½-in.) sheet iron. This flue passes horizontally over the bedding floor into a brick channel, 1,500 x 2,300 mm. (59 x 90 in.), which delivers the gas to the dust chamber, 23,000 x 12,000 x 5,000 mm. high (75 x 39 x 16 ft.) and then to the stack, 80 m. (262 ft.) high, and 2.9 m. (9½ ft.) diameter at the top. There are two dust chambers of the same dimensions. During the test one served the roasters and refinery and the other was connected to the blast furnace alone. Only the stack served all plants.

The gases from the tap hole were removed by an exhaustor[1] which was too big for the purpose. One of the proper size was not obtainable at the time. This blower exhausted into the flue between the furnace and the dust chamber. The exhaustor in this way worked also as an injector; however, too much air was passing the dust chamber and made it inefficient.

The blast-furnace blower is a KKK Rateau turbo-blower with a capacity of 160 cu.m. (5,650 cu.ft.) per minute at 1,500 mm. (34 oz.) water pressure, 2,935 r.p.m. The furnace runs generally with 65 to 70 cm. (15 oz.) water pressure, and smelts on the average 190 metric tons of total charge in twenty-four hours. Slag is tapped alternately on both short sides of the furnace; the slag flows from the spout through a covered cast-iron launder about 1 m. long, through a

[1]KKK Rateau blower, capacity 200 to 250 cu.m. air per minute at 100 to 150 deg. C.; suction, 500 mm. water; 52 hp.

hole in the charging floor into slag cars, which pass underneath the furnace in the direction of the long side. During the time the slag flows, the passage is closed on both sides of the slag car by iron doors, and the gases rise through the launder, combine with the gases from the tap hole, and are removed by the exhaustor. The full slag cars, which have a capacity of about two metric tons, are pulled under the crane, which takes them up and sets them on a track mounted about one meter above the floor, at both sides of which slag and matte pots are placed. The contents of a slag car (slag and matte) are tapped through a hole a little above the bottom of the vessel, first over a matte pot, and then, when slag comes, over a slag pot. Bottoms and skulls go back to the charge. While the slag in the pot is still liquid, hooks are introduced, and after solidifying, the slag cones are placed, with the aid of a crane, in a dumping car and taken to the dump, where the hooks are recovered.

Slag From Old Roman Dumps in Serbia

During the test most of the material smelted was rich Serbian slag averaging 8.5 per cent lead. This material came from old slag dumps in Babai, Serbia, which date from the times the Romans worked there, and shows included charcoal. The following is an average analysis of this slag, in per cent:

Pb (wet)	FeO	SiO_2	CaO	Al_2O_3	ZnO	S	Mn
8.5	32.9	31	2.9	13.2	6.4	2.3	1.5

Ag, 40 gr. per m.t. (1.16 oz. per ton)

The following materials were also smelted: Sinter, with 27 to 31 per cent lead from pre-roasted concentrates and matte, flue dust and muffle residues; then a poor, disseminated lead ore with 7 per cent lead and 7 per cent sulphur, and intermediate refinery products, as dross, skimmings, low-grade zinc oxide, and litharge. The losses in blast-furnace smelting were estimated by determining the lead in the materials charged and that in the furnace products, such as work lead, waste lead, lead matte, speiss, furnace incrustations, and flue dust. The materials of the charge were weighed accurately and continuously sampled. In the average twenty-four-hour sample the lead was determined by the wet assay; in the Serbian slag a moisture determination was also made, as the material was stored in the open.

Weights of Some Products Estimated

The different products of the furnace for each shift were separately stored, weighed, and sampled. Flue dust and furnace crusts were weighed at the end of the campaign and aliquot weights taken for the time of the test. It was not possible to weigh the slag; however, the lead losses from the stack were determined daily by sampling the waste gases in the flue not far from the stack. Tests for carbon dioxide, carbon monoxide, and temperature were made at the same place.

The results of the tests during three weeks are given in tables 1, 2, and 3. All lead determinations were made by the wet assay. Charges with 11.41 per cent lead, 12.46 per cent lead, and 15.05 per cent lead (on dry total charge plus coke ash, less the carbon-dioxide content of the limestone) gave lead losses of 17.39, 14.64, and 10.90 per cent respectively. These losses are made up of losses by the slag and through the stack only.

The waste gases contained on the average 0.732 grams of lead per cubic meter at 35 deg. C., and from the coke consumption of the furnace, taking in consideration the coke ash formed, it was calculated that 6 cu.m. of waste gases escaped per second, at a temperature of 35 deg. C. The stack losses were therefore 2.656 metric tons of lead during one week.

TABLE 1. FIRST WEEK OF TEST PERIOD

Materials Charged	Weight, Metric Tons	Weight of Lead Contents, Kilograms
Roast sinter	145.27	39,881
Zinc oxide	29.83	26,756
Serbian slag (dry)	796.635	67,714
Old cupels	2.04	832
Varés ore	37.6	3,042
Litharge	0.85	751
Total	.....	138,976
Furnace products (except slag)		
Work lead	110.955	109,102
Matte	38.772	4,149
Speiss	0.877	26
Flue dust	0.767	767
Furnace incrustations	0.763	763
Total	.....	114,807

138,976—114,807 = 24,169 kg. or 17.39 per cent loss.
Total dry charge, plus coke ash, minus CO_2 from limestone, 1,218,169 kg.
Per cent of lead on total dry charge, 11.41.
Total weight of products except slag, 152,134 kg.
Weight of slag, by difference, 1,066,035 kg., containing 1.374 per cent lead, or 14,647 kg., or 10.54 per cent of lead charged.
Stack loss = 86,400 x 6 x 0.732 x 7 = 2,656 kg.

TABLE 2. SECOND WEEK OF TEST PERIOD

Materials Charged	Weight Metric Tons,	Weight of Lead Contents, Kilograms
Roast sinter	127.580	34,357
Zinc oxide	5.1	4,652
Serbian slag (dry)	739.264	64,760
Varés ore	33.683	2,950
Litharge	33.667	31,843
Furnace incrustations	7.759	1,986
Cupel furnace ashes	.....	21
Waste lead	.....	893
Total	.....	141,462
Furnace products (except slag)		
Work lead	116.69	114,741
Matte	40.539	4,520
Speiss	0.373	11
Flue dust	0.767	767
Furnace incrustations	0.763	763
Total	.....	120,802

141,462—120,802 = 20,660 kg. or 14.64 per cent loss.
Total dry charge, plus coke ash, minus CO_2 from limestone, 1,135,052 kg.
Per cent of lead on total dry charge, 12.46.
Total weight of products, except slag, 159,132 kg.
Weight of slag, by difference, 975,920 kg., containing 1.43 per cent lead, or 13,956 kg., or 9.87 per cent of lead charged.
Stack loss = 86,400 x 6 x 0.732 x 7=2,656 kg.

TABLE 3. THIRD WEEK OF TEST PERIOD

Materials Charged	Weight Metric Tons	Weight of Lead Contents, Kilograms
Roast sinter	108.82	33,952
Zinc oxide	60.797	51,483
Serbian slag (dry)	723.218	61,474
Varés ore	35.56	3,272
Litharge	12.133	10,621
Skimmings	9.675	7,231
Furnace incrustations	10.273	2,374
Slag bottoms	14.8	858
Total	.....	171,265
Furnace products (except slag)		
Work lead	148.46	145,981
Matte	38.389	5,079
Speiss	0.18	4
Flue dust	0.767	767
Furnace incrustations	0.763	763
Total	.....	152,594

171,265—152,594 = 18,671 kg. or 10.9 per cent loss.
Total dry charge, plus coke ash, minus CO_2 from limestone, 1,138,283 kg.
Per cent of lead on total dry charge, 15.05.
Total weight of products except slag, 188,558 kg.
Weight of slag, by difference, 949,725 kg. containing 1.404 per cent lead, or 13,334 kg., or 7.79 per cent of lead charged.
Stack loss = 86,400 x 6 x 0.732 x 7= 2,656 kg.

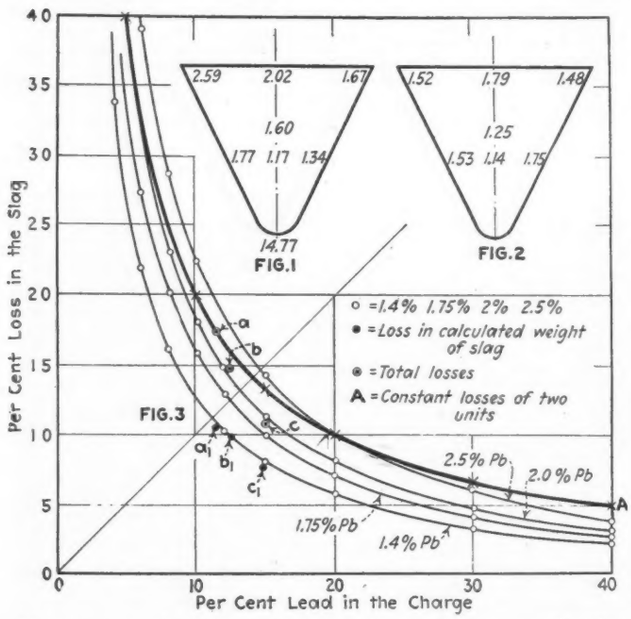
Of the total losses of 63.5 metric tons during three weeks, 7.968, or 12.5 per cent, went through the stack, and 55.532, or 87.5 per cent, was lost with the slag.

Considering the matter in another way, the lead lost from the calculated amount of slag formed (dry total charge plus coke ash, less the carbon-dioxide content of the limestone, and less furnace products),

multiplied by the average lead contents of the slag, and adding to this figure the lead lost through the stack, will amount to considerably less than the total loss found. (See tables 1, 2, and 3.) This is explained by the fact that it is unavoidable that a considerable amount of matte should go with the slag to the dump; furthermore, the lead found in the slag samples is not the average of the actual lead content, as is shown below.

Correct Sampling of Slag in Pot Difficult

The slag sample was taken from the middle of a pot of liquid slag with an iron rod, at a distance from the surface of about one-third of the height of the pot. The three-hour samples were mixed and a "dry" analysis was made; in the average twelve-hour sample, a "wet" determination was made. It was observed that a slag sample from the dump always gave more lead



Figs. 1, 2, and 3. Results of analyses shown graphically.

than the daily samples. Several slag cones were therefore broken up and samples from different parts analyzed. Figs. 1 and 2 are cross-sections of two different slag cones, and show the lead contents at different places. The average lead content of several slag cones (matte at the bottom not included) was about 25 per cent higher than the rod sample from the liquid pot; instead of 1.4 per cent, the lead content will therefore be about 1.75 per cent.

It may be of interest to record that the difference between dry and wet assay, which is usually 0.3, increased to 1 per cent during the war, as a consequence of the use of poor fluxing material.

Slag Loss More Important Than All Others

Comparing the lead lost through the stack with that caught as flue dust, it was found that more than three times as much escaped through the stack as was caught. The main reason for this was, as mentioned before, that the exhaustor which removed the tap-hole gases discharged in the flue between furnace and dust chamber, and it was, moreover, too big. If this exhaustor had discharged into the open air, the amount of lead which escaped during one week through the stack would then have been reduced from 2.656 metric tons to 1.428. Under this condition, 93.25 per cent of the total lead loss would have been with the slag, and 6.75 per cent through the stack.

From the figures above recorded it is clearly evident that in smelting materials poor in lead the loss is mainly in the slag, and that in such an operation, given a good separation of matte and slag, the most important thing is to make a slag low in lead; however, the unavoidable slag losses will always be considerable.

The following indicates the degree in which the figures obtained agree with the theoretical ones, and how the unavoidable losses in the slag change with the lead content of the materials to be smelted.

Suppose a charge with 10 per cent lead, which produces 90 per cent slag with 1.4 per cent lead; a simple calculation shows that in such an operation 12.6 per cent of the lead goes into the slag. Charges containing from 5 to 40 per cent lead give the following figures:

Pb in the Charge, Per Cent	Pb in the Slag, Per Cent	Units of Slag on 100 Units of Charge	Units of Lead in the Slag	Lead Loss, Per Cent
5	1.4	95	1.33	26.6
10	1.4	90	1.26	12.6
15	1.4	85	1.19	8.0
20	1.4	80	1.12	5.6
25	1.4	75	1.05	4.2
30	1.4	70	0.98	3.27
35	1.4	65	0.91	2.60
40	1.4	60	0.84	2.10

Making this calculation for slags containing 1.75, 2.0, and 2.5 per cent of lead, and plotting the relation between lead on the charge and lead loss in the slag, gives the curves of Fig. 3.

Plotting the results of the actual test on the same system of co-ordinates, *a*, *b*, and *c* represent the total losses of the first, second, and third week, and a_1, b_1, and c_1 are lying, it is seen, pretty well in the theoretical curve for the losses in the slag with 1.4 per cent lead; and the curve which touches *a*, *b*, and *c* is a similar one, which proves that the results of the test are reliable.

It should be remarked that the losses in the slag are even greater than indicated, for the matte produced must be treated again, and in refining the work lead about one-fifth of it comes back as intermediate products which have to be re-treated. The losses in the slag by the intermediate products, as dross, skimmings, zinc oxide, and litharge, are not of importance, as these materials are rich and, in consequence, do not make much slag. However, the losses in re-treating the matte must be considered. To take a concrete example: During the test, in the first week 3.6 per cent of the lead appeared in the matte, which assayed 10.7 per cent lead. Now, considering a slag with 1.75 per cent lead, the losses in the slag by re-treating the matte are 0.6 per cent, so that the losses in the slag during the first week rise from 13.58 to 14.2 per cent; this also does not include losses in roasting the matte.

From the above results and considerations, and from the curves, it is seen that in smelting rich Serbian slags with 8.5 per cent lead, and taking the slag product as containing, on the average, 1.75 per cent lead, as seems to be right, the slag losses alone are 19 per cent, to which must be added the loss by the stack and the loss in matte which goes to the dump in consequence of the method of handling the slag, as was the practice in this particular instance. The actual total losses in smelting this Serbian slag in the plant under discussion were 24 per cent.

USEFUL OPERATING IDEAS

Loosening Frozen Casing or Drill Pipe With Oil

An Old Idea With a New Application—Circulation Must Be First Established—Little Equipment Required

THE practice of using oil instead of water as a mixing fluid in cable tool drilling is one of long standing, according to W. W. Copp in a bulletin of the California State Mining Bureau. One advantage of its use is that the casing remains free in the hole, even when there is considerable friction. Several oil operators have recognized the possibilities of this condition and have applied the principle involved in loosening casing frozen in holes drilled with either cable or rotary tools. The application of the idea is simple, provided circulation can be established either through the casing or the drill pipe, as may be most practicable. The only equipment required is a circulating pump, flexible hose, and a pressure connection at the top of the casing.

The procedure is as follows: Oil is pumped into the casing or drill pipe through a tight head until it has replaced the fluid in the well. This necessitates its passing up around the shoe joint or drill collar along the walls of the hole to the surface. When the oil appears at the surface it is returned to the pump and again circulated. After circulation is obtained, a strain is put on the pipe to be loosened. Circulation is then maintained until the pipe comes loose. It will do this of its own accord. The length of time required for circulation varies from a few hours to three days, depending on the amount and character of the material binding the pipe.

The probable action of the oil is to work through and permeate the formation holding the casing. This causes the formation to creep and become more elastic, thereby releasing its hold. In its effect on sand, the oil has a tendency to hold it in suspension and prevent the settling or packing which occurs in water or mud fluid.

It often happens that the string of casing intended to be the water string freezes in the hole, perhaps several hundred feet above the proper depth to shut off water. This necessitates the use of an additional and smaller string of casing, which not only adds to the cost of the well but reduces the size of the hole. It is obvious that if the original string of casing can be loosened by the method described and landed at the desired depth, a long step has been taken toward the successful completion of the well.

The Union Oil Co. of California has successfully used this method of loosening frozen casing or drill pipe in a number of jobs in the Richfield oil field. In drilling one well rotary tools were used and a 15-in. hole was drilled to 1,725 ft. A "feeler," consisting of four joints of 12½-in. casing on 6-in. drill pipe, was run to bottom and could not be pulled out. Customary pulling methods were used in an attempt to loosen the casing, with the result that the derrick was pulled in. After the derrick had been rebuilt, the method described above was tried and the string successfully removed from the well. Circulation with oil was maintained for three days, when the casing began to move. It literally jumped out of the hole a few inches at a time, finally coming entirely free.

In another operation, the well was drilled with rotary tools to a depth of 3,057 ft., when the drill pipe was lost in the hole and could not be recovered. After landing 12½-in. casing at 2,009 ft., the well was redrilled from 2,200 ft. with cable tools carrying 10-in. casing and underreaming to 12¼ in. Oil was used as the drilling fluid. The 10-in. casing was successfully carried to 3,062 ft. (1,053 ft. of friction at contact with formation), where it was cemented and a water shut-off obtained. While drilling from 2,200 ft. to 3,062 ft. the 10-in. casing stuck several times. When this occurred, an additional joint was screwed on, oil was circulated until the casing was loosened, and the casing worked until it became perfectly free in the hole.

The examples cited indicate that casing or drill pipe can be loosened with this process, even under severe conditions such as described in the first instance cited. Its use has been proved to be successful, and neither special equipment nor great expense is involved in the operation.

Where circulation cannot be obtained through the frozen pipe and up along the walls of the hole, the situation is not hopeless, as has been demonstrated by the Standard Oil Co. in its well No. "M/C" 78, in the Coyote Hills field. In this well a water shut-off was obtained with the 8¼-in. casing at a depth of 3,384 ft. Drilling was continued to a depth of 3,542 ft., using rotary tools. Six and one-quarter-inch casing was run in and stuck at 3,500 ft. Circulation could not be established. However, oil was introduced between the 8¼-in. and 6¼-in. casings, and a strain put on the 6¼-in. casing. The mud fluid was bailed to 3,000 ft. and its level maintained at this depth. The oil gradually worked down outside of the 6¼-in. casing and finally appeared on the inside. When this occurred, the pipe came loose and was completely removed from the well.

Home-Made Gasoline Locomotive

BY ALLEN P. CHILD

A Texas company built a gasoline locomotive for use in its rock quarry from a truck which had been mired in a bad hole near by and which could not be removed without more or less wrecking. The motor and chassis of the truck were placed on a regular quarry car stripped of its body. Timbers running along its length and cross beams at either end served in raising the car frame. On this superstructure the motor and chassis were placed. An extension was made on the motor jackshaft, and on either side sprocket wheels were attached. To one of the timber supports along the side of the car another jackshaft with similar sprockets was attached. These sprockets measured 12 in. Attached

to the inner side of the bearing of the jackshafts of the two shafts were two 6-in. sprockets. To the journals of the quarry-car wheels two 14-in. sprocket wheels were placed in line with the small sprockets on the jackshafts. The 12-in. sprockets on each side were linked up with a chain, as were the 6-in. to the 14-in. wheels. Power goes from the transmission to the first jackshaft driving the rear wheels of the car and also to the second jackshaft driving the front wheels of the car. Running on a 36-in. gage track this locomotive can easily haul a twenty-ton train.

Safety Factors and Ways of Attaching Hoisting Ropes

It is customary to compute the factor of safety of hoisting ropes by dividing the breaking load by the maximum load or by the aggregate weight of rope, useful load, cage, and cars. The factor of safety determined in this manner is called the static factor of safety. This does not give the real factor of safety, which is difficult to determine. The approximate estimate of the minimum value of the factor of safety can be obtained by dividing the breaking load by the sum of the maximum attached weight, the weight of the rope, the accelerating force in pounds, and the bending stress caused by the rope passing around the sheave. Bending stresses are uncertain, and no generally accepted formula is available for computation. Formulæ are given in various handbooks.

In mining practice the factors of safety range from 10 to 6, figured on the basis of breaking load divided by the weight of the rope plus the suspended load. Lower factors of safety are used with greater depths, as the longer rope can better overcome the uncertain loads due to shock, vibration, and high acceleration forces than short ropes. In manufacturers' catalogs a factor of safety of 5 is usually taken. Williams gives the static factor of safety for the hoisting ropes used at the De Beers mine as ranging from 7.89 to 6 and with the bending and accelerating forces included, the factors of safety range from 3.73 to 2.7. Certain rules given in Bulletin 75 of the U. S. Bureau of Mines provide that new ropes in shafts of less than 3,000 ft. in depth shall have a static factor of safety of not less than 6. Where the factor of safety, due to wear, falls below 4.5, such ropes shall not be used for hoisting or lowering men. In 6 x 19 ropes the limit of use for handling men is reached when the number of broken wires in one lay of a rope exceeds six. When the crown of the strands is worn down to less than 65 per cent of their original diameter, or when the broken wires are reduced by wear more than 30 per cent in cross-section, the number of breaks in any lay of the rope shall not exceed three.

Where long service is expected of a rope, a high initial factor of safety should be chosen. For deep hoisting just as small a factor of safety should be selected as safe operating conditions will permit. For flat ropes a somewhat higher factor, 20 per cent greater than for round ropes, is required. This is due to the difficulty of obtaining uniform strength over the full section.

Both sheaves and drums should be of sufficient diameter to prevent undue bending stress in the rope. Sheaves are proportioned from 800 to 1,000 times the diameter of the wire in the rope. The product of 100 and the diameter of the rope can be more conveniently taken.

In attaching hoisting ropes to drums the free end of the rope is passed through a hole in the drum close to the flange, looped around the drum shaft, and secured by two or more drop-forged rope-clips. The opening in the drum should have a rope-bearing of comparatively long radius, and under the drum shell there should preferably be a casting giving a long-radius bearing to the rope seat. A sharp bend produces a serious weakening of the rope. The excess length of the rope is coiled upon the drum, and sufficient should be used to prevent the complete unwinding of the rope. The extra coils serve to prevent a direct pull coming upon the rope clamps.

Three types of rope fastenings are used at the cage end—wire rope clamps or clips, rope sockets or capels, and wedge clamps. In using rope clamps the rope is fastened by from four to six clamps. This type of fastening is common in many Western mines. Comparatively few published tests of the holding power of rope clips are available, but opinion is in their favor. A test made with a ⅝-in. plough-steel rope gave the following results: One clip, tightened with 12-in. wrench, slipped at 8,360 lb.; one clip, tightened with 24-in. wrench, slipped at 10,020 lb.; and two clips, tightened under load, broke the rope at 21,710 lb. (*Engineering and Mining Journal*, Vol. 95, p. 472.) Probably the most serious objection that can be presented to the use of the clip is the crimping of the rope beneath the U-bolt.

Socket fastenings when carefully prepared will develop the full strength of the rope. One method of preparing is to wrap the rope tightly below the position of the socket, open the rope and straighten and clean the wires first with kerosene, wiping this dry and then dip into a one-to-one hydrochloric-acid solution, holding long enough to clean the wires. Wash off the acid and wipe the wires dry with a clean rag. Bind them together and slip the socket over and then evenly distribute the wires; cover the bottom of the socket with fire clay, and pour in molten zinc. The method as described is given in the catalog of John A. Roebling's Sons Co.

The rope thimble or socket is bolted to the draw head of the cage or skip in the simplest arrangement. In other methods it is bolted to a forging, to which are attached four chains. With this arrangement the chains and connecting forging must be annealed at regular periods. Some engineers advocate the use of a rope-detaching device between the rope fastening and the cage. The purpose of the device is to detach the rope automatically and prevent the cage from falling if overwinding should occur. The plates are held in place by a copper rivet which is sheared when the hook comes in contact with the bell which is attached to the headframe. The detaching hook has been known for a long time, but its use is not widespread. It is of doubtful utility, and safety engineers rely more upon automatic overwinding devices which stop the hoist at a given position in the headframe.

Device for Igniting Safety Fuse

A device called a "lead spitter," intended for igniting safety fuse, has recently been introduced. It consists of a small lead tube, half as thick as a pencil, which incloses a train of free-burning black powder, which, when ignited, spits a continuous stream of red-hot sparks. The lead melts away as the powder burns, thus permitting a steady emission of sparks.

THE PETROLEUM INDUSTRY

Deepest Well Drilled in California Proves Dry

The deepest well ever put down in the State of California in search of oil proved to be a "dry hole," and was drilled by the Standard Oil Co. of California twenty miles north of Main Camp, Lost Hills-McKittrick Division, Kern County. After boring 6,202 ft., the company abandoned the well and has given up hope of finding oil.

The history of the "well," as narrated by E. M. Delaney, superintendent of the Lost Hills Division of the company, is as follows:

Before we could start drilling (the well was spudded in during May, 1919), it was necessary to establish a camp large enough to accommodate about twenty men. The next problem was the water supply and fuel oil. We drilled a water well 550 ft. deep near the camp site which furnished an ample supply of water for the boilers and drilling, but before the water could be used in the boilers it had to be treated. Water for domestic purposes was hauled by truck from Lost Hills throughout the entire period of drilling operations. To secure fuel oil for the boilers we laid four and a half miles of 4-in. pipe line. An average of 40 bbl. of 18 deg. gravity crude oil was used daily.

On account of hard rock overlying this territory, cable-tools were used to drill an 18-in. hole to a depth of 210 ft., 75 ft. of which was solid rock. At this depth a rotary was installed and drilled an 18-in. hole to a depth of 1,691 ft., where the 12½-in. casing was landed and cemented. We used 11¼ tons of oil-well cement and 1,500 lb. of hydraulic lime. After standing cemented fourteen days, tested 12½-in. casing for water shut-off. This tested O. K. Drilled ahead with rotary, using 6-in. drill pipe and 12-in. fishtail bit to 1,875 ft. At this depth the 8¼-in. casing, with 100 ft. of perforated casing, was set in hole to test formations below 12½-in. casing. In tests made found only a very small showing 15.5 gravity oil.

After satisfactory tests were made at this depth and formation proved non-productive, pulled 8¼-in. casing out, drilled ahead, using 6-in. drill-pipe and 12-in. fishtail bit, to a depth of 3,500 ft., where the 10-in. casing was landed without being cemented. At this depth cable tools were used again. Put in 3,500 ft. of 8¼-in. casing and carried to a depth of 3,695 ft., where 8¼-in. casing was cemented, using four tons of oil-well cement. After standing cemented fourteen days, cleaned out cement below 8¼-in. casing and tested for water shut-off. Water was not shut off. Shot 8¼-in. casing off and pulled it out. Put 8¼-in. casing back in and sidetracked casing let in hole, and carried 8¼-in. casing this time to 3,694 ft. and cemented, using four tons of oil-well cement.

After standing cemented fourteen days to allow the cement to harden, tested 8¼-in. casing for water shut-off. Water was shut off. Put 3,694 ft. of 6¼-in. casing in hole and carried it to a depth of 4,031 ft. While making a test of formations at this depth for oil, after perforating and bailing hole, froze 6¼-in. casing. After bailing water down 3,000 ft. hole showed very little oil. Cut off 6¼-in. casing at 3,650 ft. and pulled it out. Ripped 8¼-in. casing off at 3,535 ft. and pulled it out.

After sidetracking top of 8¼-in. casing with cable tools, installed rotary using 6-in. drill pipe and 10-in. fishtail bit. Drilled ahead to a depth of 4,080 ft. and set in an 8¼-in. liner at 4,080 ft. to hold junk back. Drilled ahead through 8¼-in. liner, using 4-in. drill-pipe and 8-in. fishtail bit to a depth of 5,327 ft., where the 6¼-in. casing was landed with a Texas boot on top and 5 ft. of perforations at 4,180 ft., where 3½ tons of oil-well cement was pumped through and back of 6¼-in. casing. After this was done drilled ahead, using rotary with 3-in. drill-pipe and 5⅝-in. fishtail bit, drilling through 6¼-in. casing to a depth of 6,602 ft. The formation of this well was blue shale with a great number of hard shells to a depth of 5,327 ft.; from this depth to 6,602 ft. was hard brown shale, except hard shells at different intervals.

This is the drilling history of this well, except the many long and expensive fishing jobs which usually occur while drilling in hard formation. After drilling to this great depth and not encountering any oil showings below where the 6¼-in. casing was landed at 5,327 ft., it was decided to abandon the lower portion of hole and test out formation back of 6¼-in. casing, which was done by pumping fifteen tons of oil-well cement through 3-in. drill-pipe and filling hole up to 4,773 ft. After this was done the 6¼-in. casing was perforated and the brown shale showings were tested out, which again proved to be non-productive.

Oil Prospecting in Australasia

REUTERS' TRADE SERVICE

The Commonwealth government of Australia has decided to extend the period of oil prospecting licenses in the Northern Territory from one to five years. One hundred licenses have so far been granted.

The Commonwealth Oil Refineries, Ltd., which was formed in pursuance of an agreement between the Anglo-Persian Oil Co., Ltd., and the federal government, has decided to establish refineries in Melbourne and Sydney. Four hundred acres of land have been purchased near Williamstown (Victoria), and arrangements are being made for wharf and railway accommodation, water service, electric power, and the laying of pipe lines. Tenders are to be called for the supply of oil tanks with a capacity of from 2,000 to 10,000 tons. The Sydney refineries will be established at a later date.

Boring for oil is proceeding assiduously in the several states, and the most promising indications recently have been reported from Kilmore, Victoria, and the Barcoo district, in Queensland. Operations are being continued in Victoria, despite the fact that the Ministry

of Mines characterized the ventures as "hopeless propositions."

According to advices from Wellington, New Zealand, a fresh attempt has been started to exploit the Taranaki oil wells. A start is being made with the Blenheim bore, where deposits at the 2,000 level will be tested.

Shale-oil operations at Newnes, New South Wales, are being curtailed, as the oil cannot be supplied as cheaply as it can be imported into the country. Those interested declare that there are many millions of gallons of oil in the deposits at Wolgan, but the problem is to discover an economic method of extracting it.

The Locke Oil Development Syndicate, Ltd., has been formed in Sydney, with an authorized capital of £12,000 in £50 shares, to acquire an option over a Western Australian oil concession.

Risks Great in Oil Fields of North-Central Texas

The wildcatter says, "Oil is where you find it," and he points to the oil fields in Stephens and Eastland counties, Tex., to prove that he is right. Certainly many wells whose locations were chosen at random in those counties, either without or against geologic advice, have struck oil, and many whose locations were carefully selected by enthusiastic geologists were so dry that they sizzled when the drilling water was put in. Geology of the common garden variety, planted in the region between Ranger and Breckenridge, Tex., has not produced a flourishing crop of dividends. On the other hand, there can be no doubt that geology properly applied by able men can greatly reduce the prospect of stupendous losses, such as have crippled or killed many of the companies that have essayed to develop oil in this rich field.

Unlike the Healdton, Cushing, Garber, Burbank, and other famous oil pools in Oklahoma, to the north, most of the pools in these counties in Texas are not indicated by well-marked domes or arches (anticlines) in the beds of rocks at the surface above them. To be sure, the beds that contain the oil which lies deep beneath the surface are sharply arched into anticlines and domes, and the oil, following the general rule, tends to gather at the crests of these deeply buried arches, but at some places the surface beds extend smoothly over the oil bonanzas, not suggesting by even the slightest bump or buckle the fortunes that lie far beneath them. More commonly the surface rocks are gently folded, but the folds are not of the same shape as the anticlines that hold the oil, nor do they lie vertically above them.

The task of the geologist, and through him that of the oil operator, is to discover the relation between the folds at the surface and those that his drill must strike at a depth of 3,000 ft. or more in his search for oil. He may find that the anticlines in the oil sands generally lie north of gentle anticlines on the surface, or that they lie east, south, or west of them. He may find that some of the anticlines in the oil sands lie below places where the surface beds are flat, or that steeply dipping beds on the surface are so commonly associated with anticlines in the oil sands that it is advisable to drill near them. Perhaps he may find that the surface anticlines which trend in a certain direction are reliable guides and that others are false guides, luring the operator to disaster. Any one of a great number of relations may be found, but the essential thing to keep in mind is that there is a relation and that it can be found.

Many forlorn investors in the oil fields in Stephens and Eastland counties, Tex., will testify to the desirability and the magnitude of the possible saving, for although these fields have been remarkable for their rapid development and for their many productive wells, they are no less remarkable for the high cost of drilling and operating, for the short lives of a large number of the wells, and for a multitude of dry holes. A few companies have been conspicuously successful, but many more have either barely paid expenses or have failed miserably—failed even to recover their original investment. Some of these failures are due to poor methods of operation and to the bull-like, blind policy of many of the large companies that shouldered into the field, sublimely indifferent to the repeated sickening jolts dealt them by extortionate leaseholders, by the supply companies, and by outrageously high operating expenses. Many companies that held productive leases and put hundreds of thousands of barrels of oil on the market failed to earn enough to balance their original outlay. A large percentage of the absolute failures, however, particularly those of small companies, are due to the fact that the operators did not strike oil in the single well that they had sufficient funds to drill.

How To Prevent Failure

The remedy for this waste and failure is to study painstakingly the geologic structure in the oil-bearing beds as revealed by well records, to determine the shape, outline, and position of the anticlines, and then to determine the relation between the structure far below the surface and that at the surface. Some of the strong companies have undoubtedly made such studies, but most of them guard jealously such information as they have obtained. The U. S. Geological Survey, Department of the Interior, is furnishing some assistance in the exploitation of the oil and gas resources of the country by publishing reports describing in detail the surface rocks in promising areas and containing maps showing the structure of the beds. These reports are sent from the Geological Survey at Washington to anyone requesting them. A report recently issued as Bulletin 726-G, by Clarence S. Ross, entitled "The Lacasa Area, Ranger District, North-Central Texas," describes a block six miles square in the southeastern part of Stephens County, Tex. It is not a monographic report on the geology and oil prospects of that area, but serves well as a foundation for further geologic investigation.

California Crude Oil Prices

The following are the current prices offered by the Standard Oil Co. for crude oil at the well, as reported by *Oil Field News*, San Francisco, Cal., March 15, 1922:

CRUDE OIL PRICES—SAN JOAQUIN VALLEY AND WHITTIER-FULLERTON FIELDS
(Per Barrel.)

14° to and including 17.9° gravity	$1.10
18° to and including 18.9° gravity	1.11
19° to and including 19.9° gravity	1.13
20° to and including 20.9° gravity	1.16
21° to and including 21.9° gravity	1.20
22° to and including 22.9° gravity	1.25
23° to and including 23.9° gravity	1.31
24° to and including 24.9° gravity	1.38
25° to and including 25.9° gravity	1.46
26° to and including 26.9° gravity	1.55
And for each increase in gravity of one (1) full degree above 26.0° gravity, up to and inclusive of 34.9° gravity, ten (10) cents per barrel additional; 35° gravity and above..	2.45

CONSULTATION

Commercial Grades of Magnesite

"I am interested in the various grades of magnesite that are used in the United States—that is, the common salable grades. For what purposes is magnesite mainly used? Kindly tell me the difference between dead-burned and caustic magnesite. I would like to have a few analyses of the typical domestic and foreign product."

The magnesite marketed in the United States is sold in two general classes—as crude magnesite and as the calcined product. The crude mineral is the run-of-mine product which may have received some simple treatment such as crushing, sorting, or screening before being shipped. It is essentially the raw mined mineral. Calcined magnesite refers to crude magnesite which has been roasted to remove all or part of its combined carbon dioxide.

When the magnesite is roasted at moderate temperatures, so that all of the contained carbon dioxide has not been driven off, the product is termed "caustic magnesia." Usually from 3 to 8 per cent of carbon dioxide is intentionally retained in the calcine so that in its subsequent use the caustic magnesia will readily react with water and carbon dioxide in the air in cement manufacture or with various acids in the manufacture of magnesium salts. The action is comparable with that of quicklime when mixed with water. About two tons of crude furnish one ton of calcined magnesite.

Dead-burned magnesia, as its name implies, is magnesite that has been roasted until but one-half of 1 per cent or less of combined carbon dioxide remains. Dead-burned magnesia, unlike the caustic variety, will not combine with water and slake or combine with chemicals. It is put on the market in granular form and as brick. More magnesite is consumed in the manufacture of dead-burned magnesia than in other forms.

Magnesite is used mainly in the manufacture of refractory brick for use in the basic open-hearth process of steel production and in copper metallurgy. It is used as a lining in converters, kilns for sulphuric-acid manufacture from pyrites burning, and in electric furnaces. The magnesite industry is almost entirely dependent for its prosperity upon conditions in the steel trade, which requires more than 80 per cent of the domestic consumption. No substitute has been found that will wholly take the place of magnesite refractories. High magnesian dolomites have been tried and found fairly satisfactory, but they do not make a product as highly refractory.

Caustic magnesia is used largely in the plastic trade for manufacture into cements and flooring. When mixed with magnesium chloride, a byproduct of salt manufacture, caustic magnesia is converted into Sorel or oxychloride cement, which makes an excellent flooring and may be mixed with various fillers, cork, talc, marble dust, sand, clay, asbestos, silica and other materials to be sold under a trade name. It is claimed for the use of magnesite flooring that greater resiliency is obtainable than with ordinary cements, a physical characteristic permitting lighter building construction. From 10 to 15 per cent of the domestic consumption of magnesite goes into the plastic trade, a use for the mineral which seems to be gaining in importance.

American magnesite is purer than the Austrian product, which contains a small but desirable percentage of iron. The absence of this element in the American magnesite is overcome by adding iron synthetically in the form of from 2 to 5 per cent of magnetic iron ore during the roasting of the magnesite. The product is termed a ferromagnesite or ferromagnesia.

Typical analyses of American and foreign grades of magnesite were given in articles that appeared in the Jan. 14, 1922, Feb. 4, 1922, and March 11, 1922, issues of *Engineering and Mining Journal*. Additional information is supplied by the publications of the U. S. Geological Survey in its separates on "Magnesium."

Marketing Manganese Ore

"What would you suggest as my best method to find a market for manganese pigments and other manganese concentrates?"

Before finding a market for any mineral a producer should carefully ascertain the grade or grades he is capable of producing and the amount that can be regularly delivered under a contract. Uniformity of product and constancy in mineral shipments are requirements which many mineral producers neglect to meet, frequently making the consumer resort to importations.

We have not heard of manganese being used as a pigment (coloring agent), although it is being used as a drier in paints. As a drier it is added only in minute amounts, less than 0.5 per cent, so that a small quantity of manganese produced for that purpose will go a long way toward satisfying a consuming demand. The function of a drier is to make linseed or other drying oils capable of absorbing oxygen from the air or of drying by its action. The natural manganese mineral pyrolusite, when used for that purpose, is ground to a powder in water and then dried. Pyrolusite is essentially a peroxide containing oxygen loosely combined and readily combining with other oxidizable bodies. This characteristic of manganese compounds is used to advantage in manganese driers, for when added to boiling oil the excess oxygen combines with the oil, oxidizing it, some of the manganese dissolving and forming a compound with linoleic acid in the oil.

If the prospective manganese producer is desirous of supplying the relatively small amounts of manganese used for this purpose, a good plan is to get in touch with the nearest paint manufacturers.

Other uses for manganese ore exclusive of steel making are in dry-cell manufacture, as decolorizing agents in glass manufacture, and in chemical manufacture. The specifications of manganese battery ore were outlined in *Engineering and Mining Journal* of Dec. 24, 1921. Anyone having under consideration supplying consumers of these grades of manganese ore should first investigate the local field for his product.

By the Way

Chiclet Contest Over

There are two sides to a statue, just as there are to a controversy. As seen from one side last fall, at the exhibit of the National Association of Women Painters and Sculptors, Mrs. Whitney's now famous statue was known as "The Engineer," and no one quite understood. One had a chance recently, however, to see it from an

"In the Trenches," by Mrs. H. P. Whitney. The other side is known as "The Engineer"

opposite point at the exhibition of the Society of Independent Artists on the Waldorf Astoria roof. To one's surprise and enlightenment it was called "In the Trenches." The light breaks. All is forgiven. But what sticky muck the lad is shoveling! And, incidentally, Mrs. Whitney gets the Chiclets.

In California

Shame and humiliation has humbled the native sons. California's wonderful climate has not lived up to its name. Easterners have returned with tales of rain, snow, cold and the "flu." Westerners make similar complaints. Our Lordsburg correspondent went to Los Angeles for the holidays and is only now recovering. Likewise Duncan MacGregor, a valued contributor, was almost lost to us by reason of a well-nigh fatal assault by uncalifornian weather, this in spite of a rugged Scotch constitution. MacGregor has a passion for mountain climbing, which he frequently indulges. But California was too much for him. We have decided hereafter to go to Florida or Bermuda on our annual winter vacation. Thus California loses.

Many theories have been advanced to explain this situation. One scientist holds that the north pole is moving south. This is a chestnut. What good would it do if it got there? Is not the south pole as cold as the north? The theory should therefore be discarded. Then, too, there is quite a bit of talk about earthquakes, as if they were a regular thing in California and were only ignored by the Chambers of Commerce lest they drive visitors away. All in all, California has had a bad time of it lately. The boosters, that is, the tellers of the plain unvarnished truth, almost forgot to boost. But better times are coming. The sun is getting warmer even here in raw New York. Cheer up, California.

Geology in the Filbert Islands

Although we do not intentionally wish to detract attention from our book-review page, we feel compelled to call attention to that deliciously humorous little volume, "The Cruise of the Kawa." The comments relating to the geology of the Filbert Islands, as expressed by one of the members of the exploring party, are as follows:

"It is plain," he said, "that the basalt monadnock on which we stand is a carboniferous upthrust of metamorphosed schists, shales, and conglomerate, probably Mesozoic or at least early Silurian."

"You doubtless noticed on the shore that the deep-lying metamorphic crystals have been exposed by erosion, leaving on the upper levels faulted strata of tilted lava-sheets interstratified with pudding stone."

"Evidently then," continued the professor, "the atoll is simply an annular terminal moraine of detritus shed alluvially into the sea, thus leaving a geosyncline of volcanic ash embedded with an occasional trilobite and the fragments of scoria, upon which we now stand."

Certainly this is the work of no amateur and is well worthy of such scientific humorists as Lewis Carrol and Stephen Leacock. It is quite obvious that certain promoters of mining and oil stocks, whose sole object is the exchange of beautifully engraved certificates for the cold, hard coin of the realm, have overlooked an opportunity. The Cagliostros of fake oil and mining properties would indeed have hard work presenting such a convincing display of geological phenomena.

Keen Cutters

"Seems to me, m'son," said Cap'n Dick, "I 'ave told thee stories baout mos' o' tha minin' districts in tha country, 'cept per'aps tha lead an' zinc mines daown an' raoun' about Joplin, Missouri. So 'ere gaws, jus' so thee won't think I'm partial: Seems as 'ow Jimmy Trenow 'ad been daown there some little time, w'en long comes Jan Polglaze, 'oo 'e'd nawn h'up to that Sibley mine, in tha h'iron country. Firs' thing h'off Jimmy 'ad to show Jan h'all baout tha place, so 'ee takes un h'out for a walk. If thee's h'ever been daown in that part of the country, m'son, thee naws a chap can't gaw very far 'less 'ee runs h'into some o' these 'ere razor-back 'ogs. So, sure nuff, Jimmy an' Jan runs h'into a passel o' they h'out sunnin' in a field, an' tha 'ugest 'og wuz a-rubbin' 'isself again a tree, firs' h'on one side then h'on tha h'other. 'Dam-me,' sez Jan, 'w'ot's call they?' 'Razor-back 'ogs,' sez Jimmy. 'W'ot's for that gert chap rubbin' 'isself 'gainst tha tree, you?' 'W'y, dam-me,' sez Jimmy, 'mus' be 'ee's stropping' 'isself.'"

A Suggestion

Somebody might write something on the relation of rebellious ores to the Permian revolution. We have been trying to but can't. Inspiration seems lacking. A paper on the subject would fill in a gap on the program at the next A. I. M. E. meeting—that is, one of those gaps that one would frequently like to see on the program.

SOCIETIES, ADDRESSES, AND REPORTS

Hoover Outlines Engineer's Functions at Colorado River Commission Meeting

Herbert Hoover was the guest of honor at a dinner given by the Engineering Council of Utah on March 27. With Secretary Hoover were other members of the Colorado River Commission, A. P. Davis, director of the Reclamation Service, and others. The speakers were: Mayor C. Clarence Neslen of Salt Lake City, Governor Charles R. Mabey, W. S. Norviel, of Arizona, W. F. McClure, of California, D. E. Carpenter, of Colorado, Colonel James S. Scrugham, of Nevada, Governor Mecham of New Mexico, F. C. Emerson, of Wyoming, and Governor Emmet D. Boyle of Nevada.

Director Davis was the only speaker except Secretary Hoover who held the floor for more than two minutes. He spoke of the Colorado River and its possibilities, saying that the problem of the Colorado had been under investigation by the Department of Reclamation for more than twenty years. Mr. Davis was followed by Captain F. M. Bishop, a member of the second Powell expedition, which made the first survey of the Colorado River from Green River, Wyoming, to the mouth.

Mr. Hoover in his speech dealt chiefly with the engineer's relation to the life of the community and his function in government. Most problems to-day, said Mr. Hoover, are economic and physical, and for the solution of the latter type the engineer is necessary. The engineer's life is in the open, and the results of his work are easily discernible. The engineer has nothing for sale except his own services, and he meets problems in a disinterested spirit. In matters of legislation he belongs neither to the group for or against any particular measure, as he has nothing to gain either way.

Speaking of the work of the Colorado commission—the cause of his coming to Salt Lake City—Mr. Hoover pointed out that this was the first great national problem to be presented to the engineering profession for its recommendation. The solution of the problem of the Colorado River was an interstate problem in engineering, and its solution lay on the basis of engineering facts.

Among the questions for which the engineering profession can find a solution is that of great waste in production and distribution. A super-power project planned for the North Atlantic seaboard would save a billion dollars a year by supplying central power. The development of the Colorado River possibilities would add four million hp. to the national supply. Even a moderate standardization of railroad freight cars would greatly reduce the cost of transportation.

One of the most difficult engineering problems is that of the bituminous coal industry, in which a double wage is paid for half-time employment, and 40 per cent more men are employed than are needed to get the coal for domestic requirements. It is an engineering problem to bring the industry out of its present condition of alternating profiteering and bankruptcy, and to get it back on a full time basis of employment.

Mr. Hoover's speech received enthusiastic applause. The meeting was one of the largest gatherings of engineers ever held in Salt Lake. About 600 were present.

Safety Association To Co-ordinate Work of Local Safety Chapters

The Joseph A. Holmes Safety Association, which is composed of various national societies interested in mining and metallurgy, held its annual meeting at Washington, D. C., on March 6. The following abstract of a report indicates an important additional activity of the association.

The association will now take charge of local safety societies which the Bureau of Mines has formed, in the following way: Each important mining district is visited soner or later by one of the first-aid cars of the Bureau, which remains in the locality for a sufficient time to educate the miners in first-aid work and give to those who have established proficiency a certificate or diploma. It is common practice before the instructors leave the neighborhood to organize those who have become proficient in first-aid work into a local chapter, which is organized for the purpose of promulgating first-aid work and social betterment of the miners. Frequently the local chapters lose interest in their work, through lack of stimulus from a national center. Therefore, the Joseph A. Holmes Safety Association has undertaken to organize all of these local chapters and to see that their interest is continued, so far as is possible. It is expected that many new similar chapters will be organized, both by the Bureau of Mines and by direct application to the association itself, under specified rules and regulations.

The main work of the association has thus far been to bestow medals for heroism in risking life in saving others in mining accidents.

A. A. E. Seeks Amendment of Model Licensing Law

Among the developments at the quarterly meeting of the board of directors of the American Association of Engineers, held on March 24 and 25, was the draft of a proposed amendment to the Model Engineers' License Law. This grants an engineer or surveyor registered in a state permission to practice in another state for not more than ninety days without being registered there, and without paying any fees, provided he files with the board of the state in which he is not registered a certified copy of his certificate of registration and also informs the board of his intention to practice, his address while in the state, the date of his work, and the approximate time required. Another change provides that engineers employed by partnerships or corporations may sign and seal the plans prepared by the partnership or corporation.

Prospectors Organize in British Columbia

Much interest was shown last winter in the lectures delivered by British Columbia government mining engineers to mining men. They were largely attended on the coast, and reports from the interior indicate similar appreciation. One of the results has been the organization of a Vancouver Island Prospectors' Association, Thomas Golby being selected as chairman and G. E. Winkler secretary. It is the purpose of the organization to call prospectors and others interested in mining together frequently for the discussion of matters of common interest.

SOCIETY MEETINGS ANNOUNCED

The eighth annual convention of the **American Association of Engineers** will be held in Salt Lake City, Utah, on June 5, 6 and 7, 1922.

Preliminary preparations for the **International Mining Convention**, to be held at Nelson, B. C., during the summer, are being perfected.

The Southwestern district of the **American Association of Engineers** will hold its third annual convention at Las Cruces, N. M., on April 13, 14 and 15. This district has jurisdiction over West Texas, Arizona, New Mexico, and Mexico.

MEN YOU SHOULD KNOW ABOUT

Carl Beal, of San Francisco, is visiting Washington, D. C.

R. E. Miller is making examinations in the Lordsburg, N. M., district.

W. E. Thorne recently left San Francisco on his way to New York and London.

C. A. Pierce, mining operator of Patagonia, Ariz., is in Kansas City on mining business.

O. E. Meinzer has received the doctorate degree in geology from the University of Chicago.

Walter A. Funk, mining engineer, formerly of Idaho Springs, Col., has moved to Paso Robles, Cal.

James P. Porteus, superintendent of the Bonney mine, at Lordsburg, N. M., has returned from the Coast.

H. McLeod Cobb, mining operator of Guanacevi, Durango, Mexico, is in El Paso, Tex., purchasing supplies.

George Parent, M. P., of Montreal, has been appointed a member of the board of directors of the La Rose mines.

E. A. Julian, of San Francisco, general manager of the Goldfield Consolidated, was in Reno, Nev., on March 23.

A. C. McLaughlin, of San Francisco, is in Washington conferring with Government officials on petroleum matters.

C. L. Nelson and **Roscoe Reeves** have returned to the New York office of the Sinclair Exploration Co. after extensive work abroad.

R. Frizzell, of Prince Rupert, B. C., has returned from an extended trip in the Mackenzie River and Copper Mine River districts.

H. W. Hardinge returned to New York on March 29 from a business trip abroad. He spent a month in England, France, and Belgium.

C. M. Weld, of Weld and Liddell, left New York on April 4 for Alabama, where he will be engaged on professional work for about one month.

Walter L. Reid, of the United Comstock Mines Co., is in San Francisco completing details for the milling plant now under construction at Gold Hill, Nev.

Stanly A. Easton, general manager of Bunker Hill & Sullivan Mining & Concentrating Co., returned to Kellogg, Idaho, from San Francisco the latter part of March.

E. A. Holbrook, assistant director of the U. S. Bureau of Mines, is at the Massachusetts Institute of Technology, where he is delivering a series of lectures on mining subjects.

W. R. Wilson, president of the Crow's Nest Pass Coal Co., Fernie, B. C., was recently elected president of the Canadian Institute of Mining and Metallurgy to serve for the coming year.

C. P. Ross, of the U. S. Geological Survey, is en route to Tucson to study the economic geology of the Christmas quadrangle. Later he will make a survey in the neighborhood of Arivaipa.

F. Cushing Moore, J. C. Haas, and **L. K. Armstrong** were appointed a committee recently by Columbia Section, A. I. M. E., for the further investigation of oil possibilities in and around Spokane.

J. M. Boutwell, formerly geologist with the U. S. Geological Survey, who recently finished an examination of the deposits of copper-silver ore at Morococha, Peru, visited Salt Lake City last week.

Oscar Hershey, geologist for the Bunker Hill Mining & Concentrating Co., returned the latter part of March to San Francisco, after a visit to the Bunker Hill operations at Kellogg, Idaho.

C. W. Hall, formerly assistant mine superintendent for the Tigre Mining Co. at El Tigre, Sonora, Mexico, is now superintendent of the Yoquivo Development Co., San Juanito, Chihuahua, Mexico.

J. J. Forbes, mining engineer, with the Southern station of the U. S. Bureau of Mines, left Birmingham, Ala., recently for an inspection tour of the mines in North Carolina, Tennessee, and Florida.

John S. Lutes, general manager of the Tod Stambaugh Co., accompanied by **Charles H. Claypool**, general superintendent, has completed a tour of inspection of the company's properties on the Mesabi iron range.

Dr. H. M. Payne was in San Francisco on March 27, en route to Bakersfield and Taft, where he will visit California oil fields. Mr. Payne will then return to New York, stopping at Golden, Col., and Cleveland, Ohio.

Stewart S. Bruce, formerly professor of metallurgy and ore dressing at the Michigan College of Mines, is temporarily filling the chair of metallurgy at the University of Idaho, **Prof. R. B. Elder** having a leave of absence on account of illness.

John M. Sully, general manager of the Chino Copper Co., and **E. M. Sawyer**, manager of the Burro Mountain Branch, Phelps Dodge Corporation, who have been attending hearings before the State Tax Commission at Santa Fe, have completed their work and returned home.

Robert Linton, chairman of the New York Section of the A. I. M. E., was a guest on March 28 of the Pittsburgh Section at a dinner at the William Penn Hotel. Later in the evening Mr. Linton addressed the mining and metallurgical section of the Engineers' Society of Western Pennsylvania.

H. Kenyon Burch has completed a concentrating plant at Bisbee, Ariz., for the treatment of Sacramento Hill ore for the Copper Queen Branch of Phelps Dodge Corporation, and is leaving for his home in Los Angeles, where, in all probability, he will take up general consulting work. The Moctezuma Copper Co.'s plant is nearing completion, and Mr. Burch will remain in charge until the plants have been started.

Mining and metallurgical engineers visiting New York City last week included: **Walter M. Small**, Monterey, Mexico; **Walter Graham**, Washington, D. C.; **J. P. Furbeck**, Cleveland, Ohio; **H. M. La Follette**, La Follette, Tenn.; **Walter J. Browning**, Spain, and **Oscar Lachmund**, Spokane, Wash.

OBITUARY

John Ballot, president of the Minerals Separation North American Corporation, died in New York on April 2. He was born in South Africa and came to New York in 1915 after twenty years in London as a mineral expert.

Edwin S. Shanklin died in San Francisco, Cal., on March 18. Mr. Shanklin was a graduate of the University of California, class of 1891, and was one of the first engineers in the development of the Goldfield and Bullfrog districts in Nevada.

George R. Davis, topographic engineer in charge of the Pacific division of the topographic branch of the U. S. Geological Survey, died at Sacramento on March 31. His service with the Geological Survey dates from 1898. He was forty-five years old.

Charles McKintsrey Van Cleve died at San Diego, Cal., on March 10, aged sixty-nine years. Mr. Van Cleve retired from actual metallurgical work some years ago. He was in Leadville, Col., in the early 80's and later was superintendent of the El Paso smelting plant, the Compania Metalurgica Mexicana smelter at San Luis Potosi, the Penoles smelter of the Mapimi Co., and of the Guggenheim's Monterey smelter.

John R. Tregloan died at Alameda, Cal., on March 21, of pneumonia. He was born at Hazel Green, Wis., in 1846. He came to California with his parents in 1855 and was educated in the public schools of that state, the University of the Pacific, and Oakland College. His first experience in mining was at White Pine, Nev., in 1869. From there he went to Amador County, Cal., where he was employed in the Gover and Potosi mines. Later he and his father opened and developed the South Spring Hill mine, of which he became superintendent, holding that position until he retired from active business in 1895. In 1906 he moved to Alameda, where he remained till his death.

Technical Papers

Economic Geology of Quebec—Memoir 127 of the Canadian Geological Survey, Ottawa, is a brochure of 105 pages on the "Beauceville Map-area, Quebec." The report is confined largely to the placer deposits of the Chaudière River basin, which were worked for gold from 1847 until a few years ago. Other deposits occurring within the district include ores of copper, molybdenum, and iron; and platinum, asbestos, steatite, marble, and clay. The report may be obtained on request.

Waste in the Wisconsin Zinc District—A ninety-nine page mimeographed bulletin prepared by Coghill and Anderson and published in co-operation with the Missouri School of Mines and Metallurgy and the Wisconsin Mining School discusses the experimental determination of a method for reducing mineral waste in the Wisconsin zinc district. Important losses in the practice as at present conducted can be obviated, it is indicated, by tabling and flotation. Progress toward electrolytic methods of recovering the zinc, rather than smelting, is also mentioned.

Timber Preservation—Reports of Investigations, U. S. Bureau of Mines, Serial No. 2,321, contains a paper on "Mine Timber Preservation," by R. R. Horner and George M. Hunt, which was presented at the New York meeting of the A. I. M. E., Feb. 20-23, 1922. The purpose of this paper is to point out some of the benefits and economies to be derived by the better selection, preparation, storage, preservation, and utilization of mine timber, and to give some specific information on certain wood preservatives and processes suitable for mine-timber preservation.

Mineral Resources—Recent publications in the "Mineral Resources" series, published by the U. S. Bureau of Mines, Washington, D. C., obtainable on request, include: "Cobalt, Molybdenum, Nickel, Tantalum, Titanium, Tungsten, Radium, Uranium, and Vanadium in 1920," thirteen pages; "Iron Ore, Pig Iron, and Steel in 1920," thirty-four pages; "Stone in 1920," thirty-seven pages; "Cement in 1920," twenty pages; "Tin in 1919," four pages; and "Salt, Bromine, and Calcium Chloride in 1920," nine pages.

Sulphur and Pyrites—The Imperial Mineral Resources Bureau has issued a bulletin on the sulphur and iron pyrites industry of the British Empire and foreign countries. Following the style of other bulletins in the series, statistics of production and consumption are given for the years 1913 to 1919, and the state of the industry in the most important producing countries is outlined. A selected bibliography is appended. The bulletin may be obtained from H. M. Stationery Office, Imperial House, Kingsway, London, W. C. 2, for 1s. 7½d.

Canadian Mineral Production—The preliminary report of the Mineral Production of Canada for 1921 is now available from the Dominion Bureau of Statistics, Ottawa. Total value of mineral products decreased from $237,422,857 in 1920 to $172,327,580 in 1921, but the quantity of gold, lead, zinc, corundum, and tripolite produced was greater than in the preceding year.

Bureau of Mines—The U. S. Bureau of Mines, Washington, D. C., has prepared a 185-page mimeographed report summarizing the principal investigations being conducted by the Bureau for the fiscal year beginning July 1, 1921. The bulletin may be obtained on request. Summaries of the more important work are included, but the report contains little scientific data, and consists largely of a description of what work is being done at the various stations, together with the personnel of the different staffs.

Square Set Stoping—*Compressed Air Magazine* for April (11 Broadway, New York, price 35c.) continues a series of articles on mining methods in the Butte district of Montana by publishing a five-page article giving details of timbering for the support of badly faulted ground and the procedure for the recovery of caved stopes. The description is well illustrated with diagrams and photographs.

Mine Management—Pope Yeatman delivered a most valuable paper at the recent meeting of the A. I. M. E. in New York, "Factors in Mine Management That Lead to Loss and Waste." It is published in the March issue of *Mining and Metallurgy* (29 West 39 St., New York; price $1). Institute members who are accustomed to take the contents of that magazine lightly should not overlook this paper by Mr. Yeatman.

Tunnel Ventilation—Ground has already been turned for the construction of two vehicular tunnels under the Hudson River to connect New York and Jersey City and to obviate the delays now caused by ferry transportation. Two cast-iron tubes will be used, of a maximum diameter of 29 ft., lying 60 ft. below the surface of the water, and having a span from portal to portal of 8,500 ft. The exhaust from automobiles will make proper ventilation difficult. An article in *Compressed Air Magazine* for April (11 Broadway, New York; price 35c.) describes the laboratory research work which has been done at Yale, Pittsburgh, and Urbana, chiefly under the direction of the U. S. Bureau of Mines, and shows how the problem has been solved.

Open-stope Mining—The open-stope system of mining carried out at the Spies mine, near the village of Iron River, Mich., is described in a two-page illustrated paper in *Mining and Metallurgy* for March (29 West 39th St., New York; price $1). The disadvantages of the shrinkage-stope system and the merits of the method described are outlined.

Lead Milling and Smelting — *The Canadian Mining Journal* of Feb. 24, 1922 (Gardenvale, Quebec; price, 15c.), contains a three-page article describing the Kingdon lead mill and smelter at Galetta, Ont., near Ottawa. The milling is simple, the principal apparatus being Mitchell screens, rolls, James automatic jigs, Hardinge mill, Richards classifiers, James tables, and a Callow cone thickener. The smelter consists essentially of a Newnam ore hearth. More than 3,000,000 lb. of lead was produced in 1921.

Canadian Mineral Production—The preliminary report of the mineral production of Ontario in 1921 is now available in Bulletin 43, eleven pages, obtainable on request from the Minister of Mines, Toronto. A preliminary statement of the mineral production in the province of Quebec during 1921 is available in an eight-page pamphlet obtainable from the Bureau of Mines, Quebec.

Economic Geology — *Economic Geology* for March-April (Lancaster, Pa.; price, 65c.) contains a twenty-five page article "The Geology of the Braden Mine, Rancagua, Chile," and a nineteen-page article "On the Metasomatic Processes in Silicate Rocks."

New Vanadium Mineral — In the *American Journal of Science* for March is a nine-page article describing what has been termed melanovanadite, a new mineral from Mina Ragra, Pasco, Peru. It is a calcium-vanadium-oxide. Separates of the paper may be secured from W. Spencer Hutchinson, 201 Devonshire St., Boston, Mass.

Canadian Mining Engineers—In the *Bulletin* of the Canadian Institute of Mining and Metallurgy for February (503 Drummond Building, Montreal; price, 50c.) appears the annual list of members. The arrangement is alphabetically by provinces, a method which we do not like. The membership list of the A. I. M. E., by the way, is not to be issued at all this spring, as usual, but may be published at the end of the year.

Perpetual Inventory System — The perpetual inventory is recommended to those firms "who are not satisfied that their material investment is at an efficient minimum; who suffer periodically from shortages of material; who are unable to make monthly profit-and-loss statements, who fret at the prospect of the annual physical inventory; and who are not adequately conserving their material investment by giving it the best physical care." The U. S. Chamber of Commerce has published a practical treatise on the subject, of twenty-eight pages, which may be obtained free by writing to the Chamber of Commerce of the United States, Mills Building, Washington, D. C.

Precious Metals—"The Recovery of Precious Metals From Sudbury Ores," seven pages, appears in the February *Bulletin* of the Canadian Institute of Mining and Metallurgy (503 Drummond Building, Montreal); the price of the separate being 25c.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

THE "porphyry" copper companies resumed on April 1, production to be on a limited scale at the start and gradually increased.

United Comstock, at Virginia City, Nev., has completed its 11,000-ft. haulage tunnel, which at times was driven from nine headings.

J. Parke Channing has resigned as president of the Seneca Copper Corporation and Walter Lewisohn has retired as a director.

Coal stocks are said to be equal in the aggregate to two months' requirements, but are not evenly distributed.

Hearings on the mine law revision bill are to start in Washington on April 27.

The Montreal iron mine, on the Gogebic Range, Michigan, has received orders to resume on full time as soon as possible.

A way has been provided for meeting the power needs in central and southern Arizona through laws recently enacted at Phoenix. It involves increasing the height of the Roosevelt Dam and the construction of power dams at other points.

The Premier Mining Co., in British Columbia, has declared a 10 per cent dividend, amounting to $500,000, for the first quarter in 1922. That for the preceding quarter was $400,000.

A Federal excess profits tax lien for $647,000 has been filed against the Consolidated Arizona Smelting Co.

Porphyry Copper Group Resumed April 1

Production To Be on Moderate Scale at Start — Utah Experimenting with New Flotation Cell

Announcement that the Jackling group of porphyry copper companies, including the Utah, Ray Consolidated, Chino, and Nevada Consolidated companies, would resume on April 1 was made on March 31 by Charles Hayden. Mr. Hayden stated that copper stocks on hand have been disposed of for delivery within the next ninety days. Production, he said, would be on a small scale at the start, but would be gradually increased to a rate of about 50 per cent of capacity.

The Utah Copper Co. has been experimenting at its Arthur plant with a new flotation cell used at the Ray Consolidated mill at Hayden, Ariz. About 1,000 tons per day has been handed intermittently since Jan. 1, yielding 8 to 10 cars of concentrates per week. About sixty Japanese were recently put on the track gang at Bingham. In all about 250 men are working on track repairs. The Garfield smelter has been getting another reverberatory ready.

Preparations in a small way have recently been under way at the Ray, Chino, and Nevada Consolidated plants.

Ray Hiring Old Employees

By Telegraph to "Engineering and Mining Journal-Press."

Ray, Ariz., April 3—Ray Consolidated is hiring all old employees who can be reached. It is reported that the mill and smelter will be started soon.

Federal Tax Lien Blocks Sale of Consolidated Arizona

By Telegraph to "Engineering and Mining Journal-Press."

Prescott, Ariz., April 3—Sale of the holdings of the Consolidated Arizona Smelting Co. to the Southwest Metals Co., which was to have taken place April 7, has possibly been held up by the filing, in Prescott, of a notice of a Government excess profits tax lien for over $647,000. The Southwest Metals Co. had prepared to bid $1,000,000 and had taken over gross claims of $2,300,000. The receiver for the Consolidated Arizona company, G. M. Colvocoresses, went to Globe on April 3 to appear before the Federal judge there, asking assistance.

An effort will also be made in Washington to secure relief from what is called a technical levy on profits not realized.

Ray Hercules Plan Operative

The plan to reorganize the Ray Hercules Copper Co. as the Ray Hercules Mines, Inc., was recently declared operative by the reorganization managers, effective April 5.

New Mexican Coal Mines Run Despite Strike

By Telegraph to "Engineering and Mining Journal-Press."

Dawson, N. M., April 3—The coal mines in northern New Mexico, controlled by the St. Louis, Rocky Mountain & Pacific R.R. and the Phelps Dodge Corporation, are not likely to be affected by the strike, it is thought.

Trail Smelter Lowers Penalty for Zinc in Ores

Makes Further Concessions to Shippers in Matters of New York Exchange and Lead Quotations

Prospects for independent silver-lead shippers of southeastern British Columbia have been improved somewhat by the announcement of the Consolidated Mining & Smelting Co. of Canada, Limited, that a larger proportion of the New York exchange on gold and silver is to be allowed the shipper, especially when the exchange is at a low rate. The deduction of 1½c. per lb. on the London lead quotation is to be changed to 1¼c. The penalty for zinc is to be lowered from 50c. to 30c. per unit. These concessions will give the shipper of the ordinary grade silver-lead ore or concentrate an increase of around $4 per ton on his output.

Some weeks ago J. J. Warren, president of the Consolidated company, was quoted as stating that arrangements had been made for the installation at Trail of a custom zinc plant and with its completion the minerals of the Kootenay carrying this element would not be subject to penalty as heretofore. Wide publicity was given this declaration in the province. It is understood, however, that too broad a construction has been placed upon Mr. Warren's words. It is true that a custom zinc plant is to be constructed, that zinc concentrates will finally market at Trail, and that the latest metallurgical methods will be applied to the treatment of the complex ores of the Kootenay. There is no doubt that this is

an important advance, but that the problem of economically handling these ores has yet been completely solved has not been demonstrated.

Preparing To Meet Power Needs in Central Arizona

Under the guise of an act to promote agricultural development and to extend the scope of the Salt River Valley reclamation project, the recent special session of the Arizona Legislature has enacted laws to facilitate the generation of hydro-electric power in large quantity for the mines of central and southern Arizona. The Salt River Valley Water Users' Association now has authority to proceed with work promised in raising the height of the Roosevelt Dam and in construction of power dams at Mormon Flat and at the mouth of Fish Creek, on Salt River. The statement was made before a legislative committee that much of the money for these improvements will be forthcoming from large mining interests, that would be repaid in electric current over a term of years. Within sixty miles of the new works lie the mines and plants of the Inspiration, Old Dominion, Miami, Magma, and Ray Consolidated companies, besides scores of properties of lesser magnitude. The association's lines also may be extended soon to Tucson, where electric power could be supplied to the mines of that locality, as well as to the municipalities of Tucson, Casa Grande, and Florence.

Freeport Sulphur Co. Takes Hoskins Mound Lease

The lease of the Texas Company on the Hoskins Mound sulphur deposit, near Freeport, Texas, has been taken over by the Freeport Sulphur Co. A plant will be installed and will be in operation by April of next year. A royalty of $1 per ton, payable to the Mound Company, owner of the deposit, has been assumed by the Freeport Company. In addition there is a contingent royalty, payable to the Texas Company, which will equal 50 per cent of the net profits until the Freeport Sulphur Company has realized out of the remaining profits an amount equal to its plant investment with 6 per cent interest. After that the contingent royalty will be 70 per cent of the net profits.

Hoskins Mound is a salt dome, situated about fourteen miles northeast of the Freeport Company's present mine at Bryan Mound. For a number of years it has been intensively developed by the Texas Company, which controlled it entirely, and several million tons of sulphur have been proved.

The Freeport Sulphur Company has an extra sulphur-mining plant stored at Bryan Mound, which probably will be used at Hoskins Mound. and it is stated that a railroad may be built from Hoskins Mound to Freeport. The mine at Bryan Mound may also be reopened in the near future.

Rio Tinto Dividend Passed

By Cable From Reuters to "Engineering and Mining Journal-Press."

London, April 3—The Rio Tinto dividend on the ordinary shares has again been passed.

United Comstock Haulage Tunnel Completed

Connection was made on March 27 between the Knickerbocker and Belcher shafts, completing the United Comstock's 10,000-ft. haulage tunnel in the Gold Hill section of the Comstock lode, Virginia City, Nev. The tunnel was begun in August, 1920. At times work was done from nine headings. The completion was three months later than anticipated on account of encountering difficult ground in the portal section.

Miami Smelter Running Three Furnaces

By Telegraph to "Engineering and Mining Journal-Press."

Miami, Ariz., April 3—Three furnaces are running at the International smelter at Miami, with production of copper at a rate that is the largest that the plant has known.

Tariff Against America's Copper Threatened in Japan

The Japanese government is reported to have introduced a bill in the Diet to increase the import duty on copper, brass, and bronze. Imported American copper is said to be considered in Japan as threatening the life of the industry there. No copper was imported from the United States by Japan before the war, but during and since the conflict large quantities have been received. Many smaller mines in Japan have closed and the larger ones have suspended or curtailed production.

Spanish Lead Mines Close

By Cable From Reuters to "Engineering and Mining Journal-Press"

Madrid, March 25—The uninterrupted fall in the price of lead has caused a further closing down of mines in the Cartagena basin. Interested producers are demanding measures of protection.

Channing Resigns as President of Seneca Copper

The resignations of J. Parke Channing as president of the Seneca Copper Corporation and of Walter Lewisohn as a director of that company were offered and accepted at a meeting of the Seneca directors on March 29 in New York. Their successors have not been appointed. Robert Linton, the first vice-president, will act as president until Mr. Channing's successor is chosen.

As recently announced, the Seneca board now consists of Thomas F. Cole, Robert Linton, R. M. Atwater, Jr., W. F. Bartholomew, James Deering, W. B. Anderson, George H. Tomlinson and J. Parke Channing. W. J. Uren will continue as general manager of the property at Calumet, Mich.

Company Liable for Accidents From "Horse Play"

Michigan Labor Department Holds Practical Jokers as Dangerous as Intoxicated Employees

The Michigan Department of Labor and industry has handed down a decision holding employers liable for injuries caused by the "practical jokes" of employees. They declared the employing company, by hiring a man known to indulge in horse play and permitting him to go about its plant where he could play dangerous tricks on other employees, "knowingly added an additional hazard to the employment of other men for which they are responsible." Such a man, they declare, is "a fool who is no less dangerous than a man who naturally is vicious or intoxicated," and "accidents might reasonably be expected, following the employment of such a man, and the company is liable."

The ruling is of considerable interest to mining companies, as "horse play" is prevalent among the miners, especially when going to and from their working places. Although the men are not actually at work at such times, the employer is no less liable for their safety. One of their favorite "tricks" has been for a man with rubbers on to give another man a shock from the trolley wire, the perpetrator seldom feeling any effect, but the victim sometimes being knocked down by the shock.

Montreal Mine on Gogebic Range To Be Reopened on Full Time

By Telegraph to "Engineering and Mining Journal-Press."

E. W. Hopkins, manager for the Oglebay Norton Co. on the Gogebic Range, in Michigan, has returned from Chicago with orders to open the Montreal iron mine at Ironwood on full time as soon as possible. Five hundred men will be employed, with wages a little lower than the scale of the U. S. Steel Corporation.

Gold Discovered in Bohemia

By Cable From Reuters to "Engineering and Mining Journal-Press."

London, April 1—Dispatches from Prague report that excavations now being made in the Commune of Belapod Bezdezem, in northern Bohemia, have led to the discovery of a body of gold-bearing pyrites, 12 m. thick, at a depth of 50 m. Drilling will be done to ascertain the extent of the deposits.

A. H. Brooks Now Chief Alaskan Geologist

A new major subdivision has been created in the United States Geological Survey by raising the Division of Alaskan Mineral Resources to the status of a branch. Heretofore the Alaskan work has been a subdivision under the Geologic Branch. The work will continue under the immediate direction of Colonel A. H. Brooks, whose title under the rearrangement is Chief Alaskan Geologist.

News from Washington

By PAUL WOOTON
Special Correspondent

Coal Sufficient for Two Months, But Not Evenly Distributed

Buying Power of Half Million Men Seriously Affected—Operators Feel Misrepresented.

Though the country has coal stocks sufficient to run it for nearly two months, even if no coal were mined, it is known definitely that these stocks are not evenly distributed. It is feared that once shipments from mines in union territory are suspended, because of the coal strike, it will develop that a large number of consumers have inadequate storage facilities.

Applications for priorities in transportation began reaching Washington before the strike began. One large consumer wrote to Washington on the eve of the strike to the effect that his contracts were with union mines and that his plant is so situated that his current coal supply must be taken from aboard cars. It is not known just how typical these cases are, but it is believed that an avalanche of complaints will be reaching Washington before the strike is two weeks old. Though the operators express great confidence as to their ability to maintain distribution, there is no evidence of the machinery which will be essential to its handling.

Officials at the Department of Commerce say that the coal strike comes at a particularly unfortunate time. The chief concern at the time of a coal strike revolves around the possible inability to secure sufficient supplies of fuel. No great amount of public concern is now apparent as to the supply, and as a result the average person is not worrying. That the buying power of no less than 550,000 men and their dependents is suddenly reduced materially has apparently not been considered, nor have its probable effects been weighed. The men now on strike represent 2 per cent of the able-bodied men of the country. This abrupt loss of buying power gives business, already sick, a jolt it is in no position to withstand. In addition, operators make few purchases of equipment or anything else during the time that their mines are closed by a strike.

Coal operators, generally, feel that their side of the labor controversy is not being presented by the daily press in a sufficiently comprehensive way to give the public a correct picture of their position. They realize that there is no intention on the part of reputable newspapers to misrepresent the situation, but it happens that the developments which appeal to the newspapers are those which, standing alone, put the operators in a bad light. Moreover, the public does not differentiate between anthracite and bituminous. As a result, the fact that the anthracite operators did meet their men in conference has been largely ignored, and the relatively high price of anthracite causes the great majority of the people to overlook the fact that bituminous prices have declined greatly. These instances are typical of a number of misconceptions. When these outstanding conceptions are mingled, they are like the components of an explosive. Incidentally, the operators are the ones most likely to suffer if the compound is touched off.

Bids Asked for Construction of Nenana Bridge

Alaska Railroad Now Officially Named —Will Be Complete to Fairbanks Next Year

The Alaskan Engineering Commission has called for bids for the construction of the Nenana bridge, on the Alaska railroad. The bridge will be ready for service March 1, 1923, and will practically mark the completion of the line to Fairbanks. The railroad beyond the Nenana River is now being operated as a narrow-gage, but standard-gage ties already have been placed. Once the bridge is completed, it will require a short time to set the rail over so as to accommodate broad-gage equipment. The new road has recently been officially designated the "Alaska Railroad."

The bridge to be built will be of particular interest, as it will have a 700-ft. single-truss span. To meet the requirements considerable quantities of special nickel and silicon steels will be used.

I. C. C. Rate Decision Deferred Until April 15

The decision of the Interstate Commerce Commission in the matter of a general reduction in rates, it now appears, will not be forthcoming before April 15. At present the case is being studied by the commissioners individually. If they should find themselves in substantial accord, the decision probably could be handed down as early as April 15, but important differences between them obviously would considerably extend the time.

Weight of Gasoline Per Gallon To Be Considered

The Interstate Commerce Commission has suspended until July 29 the proposal of railroads to cancel the estimated weight of 7.4 pounds per gallon and to substitute actual weight per gallon on crude or fuel oil from Kansas, Missouri, Oklahoma, and Texas to Arizona and New Mexico and to Cananea, Mexico. The case will be heard before an examiner of the commission on April 10 at Chicago.

Hearings on Mine Law Revision To Start April 27

W. R. Ingalls Asked To Be First Witness—Planned To Get Views of All Concerned.

Public hearings on the bill proposing an extensive revision of the United States mining law will be begun on April 27 before the Committee on Mines and Mining of the House of Representatives. Representative Rhodes, the chairman of the committee, says that every effort will be made at this hearing to build up a comprehensive record which will contain the views of all concerned in this much-controverted matter. He declares there will be no effort to rush legislation through, but after full opportunity has been given to all concerned to present their views, the committee expects to take definite action based on the conclusions which it will draw after having heard all of the testimony. An effort will be made to give wide circulation to printed copies of the testimony as the hearing progresses.

Mr. Rhodes has asked W. R. Ingalls, chairman of the committee which drafted the bill introduced by Representative Arentz, to be the first witness. He also hopes to have other members of the Ingalls committee testify at the opening of the hearing, so that other witnesses may have clearly in mind the painstaking efforts which were made by this committee to secure the most practical suggestions on which the changes proposed are based.

District West of Mount McKinley Promising, Commission Says

The Alaskan Engineering Commission in its report for 1920, which has just been transmitted to Congress, states that there is a mining district in Alaska to the west of the McKinley National Park which is showing promising mineralization. In the past, owing to its isolation it has not been worked extensively, but the commission regards it as a probable source of a large mineral tonnage. The Alaska Road Commission recently has focused attention on this zone and has had surveys made with a view of improving roads leading to it. Generally, there has been a slowing down of efforts of the small gold prospectors in Alaska and the commission does not anticipate the working of low-grade ores at a profit for several years.

Government's Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended April 1 amounted to 193,000 fine ounces. This brings the total purchases under the Pittman Act to 101,485,608 fine ounces.

News by Mining Districts

London Letter

Colombian Mining and Exploration Co. Without Reserves—Buena Tierra Mine a Failure Thus Far

BY W. A. DOMAN

London, March 21—Shareholders in the Colombian Mining & Exploration Co., upon which E. C. Heinemann, one of the directors, has just reported, have received something of a shock. Who is responsible for the high hopes held out in 1920 concerning the Marmato Hill properties is not clear, but certain it is that documents exist stating that the company's gold fields are several miles in extent, and that, at that time, well over 500,000 tons of about 10-dwt. ore had been developed. In fact, "the workings so far have only been scratched." This was good enough for the market, and brought the shares up to a high price—something like £3 in fact. Now it appears there are no ore reserves. Frank B. Powell, general manager, has informed Mr. Heinemann that the main oreshoots opened up by previous managers have had the cream of the ore taken from them, and in no instance was the mine blocked out ready for stoping.

It may, perhaps, be remembered that some stir was made two years or so ago by reports of a deposit of *anchadura* of fully 300,000 tons, valued at £1 per ton net profit. Mr. Heinemann makes no reference to this *anchadura*. The position, in fact, at Marmato, for keeping a 10,000-ton plant employed—and this is the size of the plant under consideration—does not appear to be exceptionally favorable. Mr. Heinemann evidently entertained some such view, for during his visit to the property he acquired on behalf of the Colombian Mining & Exploration Co. the Echendia mine from Norman Jenks and his brother. Some capital assays are mentioned in connection with orebodies on this property, and if the veins should continue to develop in the same manner, the purchase price of £125,000 may be warranted. Mr. Heinemann describes himself as only a layman, and it is therefore somewhat unfortunate that, in reference to the Echendia, he says: "The potentialities are so obvious that I will not insult your intelligence by calling attention to them." The Echendia ore, he says, is amenable to cyanide treatment, and it is anticipated that an extraction of from 80 to 90 per cent can be made.

It is seldom that the chairman of a mining company has to confess himself in the wrong, but R. T. Bayliss, of the Exploration Company, did so at the meeting of shareholders last week. He admitted that he was responsible for the investment of the company's funds in the Buena Tierra mine, and up to the present the property has proved to be a failure. The reason of the failure is, that Mr. Bayliss was over-sanguine with regard to the quantity, not the value, of the ore exposed in the mine at the date of his visit. At the ruling price for lead, the mine cannnot be operated at a profit, though this is not the sole reason for its closing down. There was not sufficient ore exposed, either in grade or quantity, to defray the cost of extraction and treatment. Development work during the past two years has been disappointing. Mr. Bayliss, nevertheless, is not altogether despondent, and thinks that when costs are lower the mine will experience the same change of fortune that others in the country have had.

A general sigh of relief went up when it was announced that the revolution on the Rand had been quelled. For revolution it proved to be, and not merely organized protest against the proposed reduction of white miners' wages. The prospect now for mining on the field is much brighter than for many years, and calculations are already being made on the basis of reduced expenses, and the possibility of raising much needed capital in connection with various companies.

TASMANIA

Electrolytic Zinc Co. of Australasia Increases Output

The Electrolytic Zinc Co., at Risdon, Tasmania, during the four weeks ended Feb. 8 produced 1,400 tons of zinc, as compared with 1,238 tons during the preceding four weeks, and 382 tons for the four weeks following the start of operations. The product for the four weeks ended Feb. 8 contained 222 tons of lead and 36,277 oz. of silver. This is sent to Port Pirie for realization.

Rail Tonnage in Last Quarter of 1921 Over Half From Mines

Products of mines contributed 131,224,680 tons to the 246,488,989 tons of freight handled by the railroads during the last quarter of 1921. The freight furnished by mines shows the falling off of more than 62,000,000 tons, as compared with the fourth quarter of 1920.

The principal losses in tonnage were in bituminous coal and in iron ore, although each mineral commodity, with the exception of asphalt and salt, contributed to the decrease. The detailed figures, which are those of the Interstate Commerce Commission, are as follows:

	Fourth Quarter, 1920 Tons	Fourth Quarter, 1921 Tons
Anthracite coal	21,224,244	18,820,581
Bituminous coal	110,522,086	77,443,806
Coke	6,871,501	3,029,036
Iron ore	20,605,039	4,370,568
Other ores and concentrates	3,843,791	904,801
Base bullion and matte	120,918	68,064
Clay, gravel, sand and stone	26,232,054	23,199,670
Crude petroleum	1,590,738	1,493,371
Asphaltum	309,590	416,640
Salt	642,172	771,941
Other products of mines	1,451,284	706,202
Totals	193,413,417	131,224,680

Melbourne Letter

Mount Lyell Restricts Operations Further — Conditions of British Contract for Zinc Concentrates

BY PETER G. TAIT

Melbourne, March 6—Further restrictions of operations are announced by the Mount Lyell M. & R. Co. (Tasmania) as a result of the failure of the arbitration court to grant them relief in rates of wages and labor conditions. The directors, after returning from a visit to the mine, recently announced that the Mount Lyell mine would be shut down, experiments having proved that concentrates from the North Lyell ores can be smelted without the addition of the low-grade pyritic ore. To make up the required tonnage of ore, the concentrator is to be immediately extended to enable it to treat 10,000 to 12,000 tons of North Lyell ore per month. The directors state that despite all the economies introduced and increased efficiency obtaining during the last twelve months, operations on the basis now outlined cannot be maintained without a loss, and unless the courts grant relief or the price of copper improves, the situation will have to be reviewed in six months.

As to other Australian copper producers, Wallaroo has closed down, and Mount Morgan is preparing to reopen, but to what extent is not apparent. The Cloncurry field is dead, but British and French capital is forthcoming to develop the Elliott group. The Chillagoe state mines and smelters in Queensland are controlled by an optimistic politician who has been holding the copper produced during the last six or twelve months waiting for the rise in price. Doubtless if he holds it long enough a better price will be realized, but whether it will show a better financial return after allowing for interest, storage and other charges remains to be seen. In any event, few companies can allow their money to be tied up indefinitely. He maintains that Chillagoe, with its small output, can produce copper at as low rates as the large American properties. He talks of reducing the cost of production, but wages are not to be touched. The only item he can point to is coke. When locally produced coke is available from the Mount Mulligan property, coke will cost about £3 per ton, as against about £5 at present. Chillagoe does not possess natural advantages, the mines are small, and their situation entails heavy cost for transport on incoming supplies and outgoing shipments of bullion.

According to recent press cables received in Australia there has been some discussion in the British House of Commons regarding the contract entered into between the British Board of Trade and the Zinc Producers' Association. In that discussion it was stated that the Board would take the earliest opportunity of terminating the contracts, but although several members desired

explicit information as to the rates to be paid for concentrates, the government refused to divulge the information.

It may therefore be of interest to set forth the conditions attached to the contract, as published in *Chemical Engineering & Mining Review:*

"The contract was for the period of the war and ten years after, including the stocks on hand at the end of 1917, which were purchased at the flat price of 66s. per ton on the stacks at Broken Hill. The scale of future output was made over three periods: First, during the war and one year after; second, four years after that; third, five years after that.

"1. During the war and one year after: 250,000 tons annually at the following prices: 100,000 tons at 90s. per ton, f.o.b. Port Pirie; 100,000 tons at 80s. per ton, f.o.b. Port Pirie, and half of any profit on resale; 50,000 tons at 80s. per ton, f.o.b. Port Pirie.

"2. Four years after that: 300,000 tons annually at 90s. per ton, Port Pirie, and half the profit on resale, less 100,000 tons to be allotted to British smelters.

"3. Five years after that as No. 2 period.

"The assay basis for the whole period is: Zinc 47 per cent, lead 7 per cent, silver 10 oz. per ton; any variation at the rate of 4s. per unit zinc, 1s. 3d. per unit lead, and 1s. 3d. per oz. silver. No payment for silver if under 5 oz. per ton. Excess freight over 60s. to be halved, but the price to be not less than 80s. per ton in any case."

The journal above mentioned, in commenting on the position, states:

"As a rough estimate of the value at these prices, it may be mentioned that on the basis of pre-war freights and smelting rates spelter would have to be about £28 per ton to warrant the price being given. With freights about 10s. per ton higher than pre-war and smelting rates on a higher basis, and spelter ranging about £25 per ton, it can be seen that the contract cannot be a favorable one to the British government, and also that there is no likelihood of any surplus being divided with the producing companies."

Granby Consolidated Building New Reservoir

Prince Rupert—Exceedingly cold weather during February and the early part of March has greatly reduced the output of a number of chemical and metallurgical plants in the northern part of British Columbia, by holding the snow in the mountains and freezing the streams and creeks. Thus those plants that were dependent on water power either had to close entirely or considerably curtail their output. The Granby Consolidated Mining, Smelting & Power Co., for example, had to shut down three of its four large blast-furnaces. Milder weather recently has released the water, and the plants are resuming operations. The Granby company, to avoid the possibility of the recurrence of such a delay, has begun the construction of a 25,000 acre-foot reservoir, one and a half miles higher up Falls Creek than its present reservoir. The company is constructing a temporary railway to haul material for the construction of the dam.

CANADA

British Columbia

Premier Declares Half Million Dividend for First Quarter—Portland Canal District Showing Activity

Sandon—Edward T. Davey, of Tacoma, Wash., president of the West Hunter Mining Co., examined the American Boy property, on Reco Mountain, last month. This mine shipped considerable crude ore in the early days of the Slocan. The property is owned by the American Boy Mining Co., but has been inactive for about fifteen years. It is believed that the West Hunter Co. has an option on the group, as Mr. Davey made an announcement to the effect that operations are to be resumed this spring, with W. J. Smith, superintendent of the Tamarack & Custer, in charge.

Nelson—The raise being put up from No. 3 to No. 2 levels of the California mine, near here, is nearing completion, with 190 ft. finished by the end of March and 15 ft. unfinished at that time. This work will connect all levels of the mine, which will then be in condition for steady production. Milling operations will be started early in May, it is believed.

Grand Forks—Six mineral claims, formerly held in the name of Herbert W. Young, of this city, managing director of the Maple Leaf Mines, Ltd., have been handed over to that company, following the starting of litigation over the property.

Trail—Ore shipments received at the Consolidated smelter from March 15 to 21 totaled 11,062 tons, all from the company's mines.

Alice Arm—The Portland Canal mining district is beginning to stir, although the open season must be considered some distance away. A new bridge is being thrown across Bear River by the provincial government. This will make easy of access the Marmot and Bitter Creek section, where there will be much prospecting this summer. The Premier Gold Mining Co. has been at work all winter, and with the opening of its new aërial tramway has begun making regular shipments. The country adjacent to this company's property has been widely staked, and substantial investments will be made in the prospecting and exploring of this area.

It is interesting to note that the Premier Mining Co. on March 30 declared a dividend of $500,000 for the quarter ended March 31, on its capitalization of 5,000,000 shares of a par value of $1 each. Following as this does the payment of a dividend of $400,000 for the quarter ended Dec. 31 last, the Premier appears to be realizing rapidly the anticipations of the most sanguine.

The Independent group on Goose Creek is being extensively developed by the Fitzgerald Brothers. Supplies have been taken in over the snow, and work will continue all summer. There are reported to be three large parallel mineralized zones on the property. On Bitter Creek the L. L. & H. group is said to be showing good results. A large tonnage of milling ore has been proven.

The Drum Lummon mine, at Hartley Bay, in northern British Columbia, is likely to be developed, it having been announced that $275,000 has been secured in New York for that purpose. The building of a new camp, a dock, and a railroad and the installation of a new compressor plant are planned. There are three large veins, and it is intended to open them up at depth. Some high-grade copper-gold ore has been taken out so far.

Ontario

"Blue-Sky" Legislation Dropped—Removal of Discovery Clause From Mining Act Sought— Boom in Gold Stocks

Cobalt—It is understood that the Ontario government has decided not to proceed with the "blue-sky" legislation as drafted by A. H. O'Brien, after a long investigation. The policy that will in all probability be followed is an amendment to the Ontario Companies' Act which will necessitate promoters giving more definite information of their organizations than is now demanded. Machinery will be provided to check up the information and provisions made for speedy prosecutions for illegal actions.

The Minister of Mines is sponsoring a bill in the Ontario Legislature to amend the Mining Act, the proposed measure embodying some radical changes. If the amendments are made law it will not be necessary to make a discovery of "valuable mineral in place" to secure the rights to a mining claim. As now constituted, the act requires that the prospector make a sworn affidavit that he has discovered valuable mineral, and although under the present act most prospectors commit a mild form of perjury, it is felt that this clause has something to commend it. Many persons interested in mining feel that altogether too many changes are being made in the Mining Act, and, as a matter of fact, few engineers are now able to recognize it. It is also felt that the mineral rights which constitute one of the region's greatest natural resources are rapidly being taken up, and that in a few years it will be necessary to take back parts of these areas upon which no attempt has been made to prospect or develop. If the discovery clause is removed one of the easiest methods by which undeveloped and unprospected claims could be made to revert to the Crown will be eliminated. The proposed bill also makes a large number of other changes in the act, but the elimination of the discovery clause is the most important.

Provision is made in the bill for the operation of the Temiskaming Testing Laboratories by the Department of Mines and the purchase of small shipments of ore from prospectors. Extra

powers are conveyed to the Mining Commissioner, the most important giving him the right, formerly held by the Minister, to transfer to active partners the rights of those who do not perform work or pay lease rentals or who have allowed their mining licenses to expire.

Northern Ontario is experiencing, what it has not enjoyed for many years, a real boom in the gold stocks. Practically every stock in the list has had a big advance, and in some instances this has amounted to as much as 400 per cent. Though brokers, and particularly mining brokers, have been looking forward to this for some time, when it did come it took them rather by surprise, as they did not expect a real bull market in mining stocks until next fall. In a great many properties mine developments and general conditions justified enhanced prices for the shares, but with a number of them the bull movement has been much overdone. The public, however, is taking an active interest in the gold stocks, and, as is usual in a rising market, have lost all sense of values.

Ex-Speaker Rhodes of the Dominion government, now president of the British American Nickel Corporation, has closed a satisfactory contract with the British Metals Corporation as exclusive agent for the company in Britain and Europe. The various nickel companies are exceedingly active in trying to find new markets for their products and in developing new metals for its use. Monel metal, which is produced by the International Nickel Co., is now being used in a large number of industries, and recent developments indicate that a considerable quantity may be used in the pulp and paper mills, where its non-corrosive qualities make it extremely valuable. It is also extensively used in the coal-washing plants, where the water contains a large amount of acid. The Mond Nickel Co. has purchased a small rolling mill in Pennsylvania with which to roll sheets and bars. A great deal of attention is also being paid to the development of new alloys, and it is understood that satisfactory results have been obtained by the addition of about 25 per cent of aluminum to monel metal. The disarmament proposals will cut off a large part of the market which nickel companies have previously supplied, and to survive it is essential for the companies to find new uses for their product.

Negotiations are practically concluded between the Dominion Reduction and the Peterson Lake for the retreatment of the large tonnage of old tailings.

During February Nipissing produced ore of an estimated net value of $161,000 and shipped bullion from Nipissing and customs ores of an estimated net value of $131,695. The low-grade mill treated 7,081 tons and the high-grade plant 170 tons. The refinery shipped 200,745 fine ounces of bullion during the month.

ARIZONA

Magma's Smelter To Be at Mine—Greenway Announces Plan for Power Dam at Peach Springs—Verde Central on Three Shifts

BY JAMES H. MCCLINTOCK

Phoenix — From Superior has come word that the Magma Copper Co.'s new smelter is to be built at the mine, and not at old Pinal or Magma station. General Manager Browning returned from New York with full approval of his plans, which are now awaiting only the funds already provided for by the directorate. Though Magma is showing better with depth, it is believed that it has a good future also in the Lake Superior and Arizona ground acquired several years ago on both sides of the Queen Creek gorge, just above the Superior townsite.

Jerome—Verde Central is operating three shifts, drifting on the 650 level and sinking the shaft, which is now more than 75 ft. below that level. Operation is somewhat handicapped by limited hoisting ability.

Two steam-shovel shifts are working at the United Verde and are contributing to a degree to the stockpiles at the Hopewell tunnel. The Kansas City Structural Steel Co. has been awarded a contract for the steel of the new United Verde crushing plant.

Bisbee—General John C. Greenway, manager of the Calumet & Arizona, states that application has been made for authority to build a power dam north of Peach Springs, across the Colorado River channel, and that favorable response is expected soon. The plan is backed by a number of Arizona mining interests. In no way, it is claimed, does it conflict with the Government's Boulder Canyon project or with the Edison plans at the head of the Grand Canyon, near Lee's Ferry. General Greenway says also that the proposed railroad from Ajo to the Gulf of California can be constructed, according to a recent estimate, for $3,000,000, considered low in view of the resultant lowering of freight expense.

Tombstone—Owing to the burning of a bridge on the Tombstone branch of the El Paso & Southwestern, most of the mines of the district are without fuel and have been forced to close temporarily.

Chloride—The Brunswick has completed unwatering of shaft and main level. One shift of machine men is driving this drift to the south, where it is hoped to strike the oreshoot.

Tuckahoe has resumed shipping high-grade silver ore to the Midvale smelter. Contract has been let for 500 ft. of drifting into new ground on the north.

Dardanelles new electric equipment is arriving at the mine. A 400-ft. compressor and 50 hp. hoist are the main items. Power line, road, and building construction for the new shaft is progressing. It is planned to sink 400 ft., connecting with the present workings at the 200 level. A new level will be driven under the ore at the 400 level.

NEW MEXICO

Colorado Fuel & Iron Co. To Take Silver City Manganese Ores—Aztec To Enlarge Mill

BY JAMES P. PORTEUS

Silver City — The Colorado Fuel & Iron Co. has contracted for manganese ores to be shipped to its Pueblo, Col., plant. These ores will come from the Boston Hill and Chloride Flat properties in the Silver City district. E. A. Perrault is making arrangements to start work at once, having taken a lease on Boston Hill ground. L. P. Goodier, of Denver, has taken leases from the C. Armory Stevens estate on Chloride Flat and on ground on Boston Hill also. It is expected the total daily shipments will be 200 tons.

Steins—McGee Brothers will change their original plans and install steam-power equipment in place of internal-combustion engines recently tried out on their zinc property at Steins. They are in the market for a 170-hp. water-tube boiler, a 150-hp. engine and a complete condensing plant.

Baldy—The Aztec Gold Mining Co. intends to enlarge its mill and is in the market for milling equipment. Its post-office address is Ute Park, N. M.

UTAH

Victoria's Most Productive Orebody Opened at Greater Depth

Eureka — Ore shipments from the Tintic district for the week ended March 24 amounted to 154 cars, compared to 144 cars the week preceding. Shippers were: Tintic Standard 43 cars; Chief Consolidated, 38; Iron Blossom, 19; Victoria, 17; Eagle & Blue Bell, 13; Colorado, 11; Swansea, 5; Gemini, 3; Centennial-Eureka, 3; Bullion Beck, 1; Eureka Mines, 1.

At the Victoria, the orebody from which has come the largest production of the mine in the last year's output has been opened at greater depth on the 1,875 level. In January, 1921, the mine shipped 1,633 tons, and this was about the production until the middle of the year, when the output was cut on account of smelting conditions. In July, owing to the finding of a new orebody, production was increased so that an average output of around 3,500 tons per month was maintained for the rest of the year. Production for 1921 amounted to 27,671 tons, an increase of 15,076 tons over 1920. Net smelter returns for 1921 were $308,620.

At the Grand Central the tramway is undergoing repairs, which operation is necessitating the storage of ore in the mine. Upward of forty railroad cars are awaiting shipment by lessees.

Smith-Hovland Suit Up Soon for Final Argument

The noted Smith-Hovland suit, that took nearly a year of hearing in a special master's court in Tucson, Ariz., and which involves more than $1,000,000 in the settlement of an established partnership that had been denied, is to be submitted soon in the Federal Court at Tucson for final argument.

MONTANA

Butte & Superior's Copper Ore on 2,600 Level Leaner—Barnes King Explains Decrease in February Bullion Output

By A. B. Keith

Butte—The copper ore showing in the two faces of the drift on the 2,600 level of the Black Rock mine of the Butte & Superior Mining Co. recently has been considerably leaner as compared with the grade of the ore cut when the crosscut first picked up the vein at this depth. But so little drifting has been done at this point on the copper vein that any definite conclusion as to what might be shown on the 2,600 level cannot be attempted. Assays across the face have been running around 1 per cent copper, as against 5½ and up to 7 per cent in that section of the vein where it was entered by the crosscut. The drift on the vein on the 2,600 level, according to reports from the mine, has been driven only about 50 ft. Raising is in progress from the 2,200 level, with the top above the 2,100, where it is in copper ore running up to 7 per cent.

Butte & Superior is operating now at approximately 90 per cent of normal, which is considered to be 1,000 tons of ore mined and milled. This output, it is estimated, will afford the Anaconda sufficient concentrates to yield about 7,000,000 lb. of zinc monthly.

The Barnes-King Development Company reports bullion production for February at $14,432.51. The lower output as compared with previous months is explained in an official statement as follows: "In the mill a concentrating table was started working between the Chilian mills and tube mills, and about 400 lb. of concentrates per day, carrying high gold values, with some lead and copper, are being taken out of the circuit. These will be leached and finally shipped to the smelter, but the bullion record will be out of proportion until this is under way."

WASHINGTON

Minorca-Homestake Financing Arranged—Bead Lake Company Preparing to Start Mill

Bossburg—Arrangements are being completed for financing on an adequate scale the Minorca-Homestake Mining Co., representing a consolidation of several groups of claims north of this point and which will enable the company to equip and adequately develop the ground. Some silver-copper-gold ore has been opened up, and awaits further development operation.

Newport—The Bead Lake Gold-Copper Mining Co., with holdings on the east side of Pend Oreille River, is securing connection with the transmission line of the Intermountain States Power Co. on the opposite side of the river, and as soon as that is finished, operation of the 100 ton mill, completed last year on the Conquest group ground, can be started.

IDAHO

Coeur d'Alenes District

Bunker Hill & Sullivan Orebody Cut One Mile From Apex—An Example of High Freight

By Alfred J. Dunn

Wallace—At a vertical depth of 3,500 ft. beneath the surface and fully a mile from the apex following the dip of the vein, the Bunker Hill & Sullivan orebody has been found without change in size or mineral content. It has just been intersected by a crosscut from the shaft, a distance of about 800 ft., on the new No. 16 level, which is 1,400 ft. below the Kellogg or main working tunnel. The oreshoot, where cut, is only about 10 ft. thick, though it is expected to show up much wider when explored by drifts, conforming to conditions above. In the levels above the oreshoot has been from 1,200 to 1,400 ft. long and in places 80 ft. thick, all of high-grade milling ore.

One of the large operating mining companies in the Cœur d'Alene district recently received a carload of blacksmith coal from the mines at Eccles, W. Va. The shipment was 30½ tons, and its cost was $2.75 per ton at the mine, making the value of the consignment $84.43. The freight rate from Eccles to Wallace, Idaho, was $17.88 per ton, making the freight charge against the coal $548.92, or more than six times the value placed on the shipment.

The Hercules and Tamarack, commonly referred to as the Day mines, show no signs of activity. Everything indicated that the Tamarack was preparing to start between the first and middle of March when the death of Eugene R. Day occurred in February. His will gave everything he possessed to his two brothers and two sisters, and made no reference whatever to his widow. Mrs. Day has announced her legal right to all the community property under the Idaho law. The value of the community property is placed anywhere from a million dollars up, and Mrs. Day says that, though she is entitled to all of it, she is willing to take half in full settlement rather than fight it out in the courts. Harry and Jerome Day are executors of the estate, and it is not regarded likely that they will agree to such a settlement, and the case will therefore probably go to the courts. The popular impression is that the mines will remain idle.

CALIFORNIA

Mountain Copper Co. Shipping 600 Tons of Pyrites Daily.

San Francisco Correspondence

San Francisco—The California State Mining Bureau is gathering information on placer mining in California with the object of stimulating interest in this kind of mining. Apparently there are many neglected opportunities for gold production in placer, drift, and hydraulic mining ground. Carefully compiled and accurate information on this subject will be welcomed by mining men of the Coast, it is thought.

In northern California, the Mountain Copper Co. is shipping 600 tons per day of pyrites to chemical works in the Bay region.

A. Jacquemart, of San Francisco, is making preparations to work the Gallea gravel mine near Sawyer's Bar; a ditch is to be constructed from the Little North Fork.

The American & Italian Mining Co. is hydraulicking at the Paulsen ranch, near Lewiston.

The Valdor dredge is being dismantled preparatory to being moved to new dredging ground.

On the Mother Lode, articles of incorporation of the Gold Cross mine have been filed. The new company will operate the Omega mine near Jamestown.

Elsewhere, the Slate Range Consolidated Mining Co. is milling forty-five tons of ore per day. The property is in Inyo County, eight miles northeast of Trona. At Randsburg, the Pittman group of claims in the northern part of the Rand mining district was reported sold by H. G. Nosser to Bakersfield mining men.

NEVADA

Simon Silver-Lead Again at Capacity—Tonopah Has First Bullion Theft—Eureka Nevada Railroad Neglected

From Our Special Correspondent

Mina—The Simon Silver-Lead Mines Co.'s mine and mill are again operating practically at capacity. Wages were cut at this property on March 1 and a period of reduced production resulted until the necessary crews were obtained. On account of bad roads, due to excessive snow and rain, it is temporarily difficult to transport concentrates to the railroad. The company is now negotiating for the use of the roasting plant of the Goldfield Consolidated, at Goldfield, to roast the zinc concentrates before shipment to the plant at Harbor City, Cal.

The West End Consolidated's operations at the Mabel mine, adjoining the old Garfield mine on the west, are said to be promising. Values are in silver and gold.

Tonopah — Recent bullion shipments from this district are as follows: Tonopah Belmont, $108,352; West End, $56,000; Tonopah Mining Co., $60,000; Tonopah Extension, $66,000, and MacNamara, $10,000. These shipments represent the clean-up of operations for the first fifteen days of March.

A 65-lb. bar of bullion, valued at approximately $1,200, was stolen from the express company's truck at the depot on March 24. This is the first bullion theft on record in Tonopah, and about $150,000,000 has been shipped.

Divide—The New Tonopah Dividend Mining Co. reports that a drift on the 200 level has shown commercial values for over 200 ft. Preparations are being made for building an ore bin and to begin shipments to Tonopah mills.

The Tonopah Divide's January production was 1,598 tons, and net recovery $41,686. February production was 1,476 tons, and net recovery $38,000. Shipments continue at the rate of fifty tons per day. Regular development is being accomplished, with no new discoveries reported. The south crosscut on the 265 level has not yet picked up the Gold vein. This Gold vein was worked years before the Divide silver vein was discovered, but only shallow surface work was done.

Eureka — The Eureka Nevada railroad, owing to the fact that the track has been washed out in several places, has been inoperative since March 17. The railroad company has shown no active inclination to repair the damage and resume service, and the Public Service Commission is interesting itself in conditions.

Operations in Pioche District

BY E. C. D. MARRIAGE

Pioche—Shipments from the Pioche district for the week ended March 31 indicate that conditions are approaching normal. Tonnage shipped was: Black Metals, 360 tons; Bristol Silver, 250; Prince Consolidated, 50; Mascot, 45; Combined Metals, 45; Alps, 10; total, 760 tons (compared with 682 tons the week before).

Work has been started at the Silver Dale mine, at Silverhorn, the scene of a spectacular boom just a year ago. Operations are in charge of R. K. Brown, of Tonopah.

The new shaft at the Bristol Silver Mines is almost completed, and shipments will now be increased from the present average of forty tons daily to seventy-five tons daily.

Ely—Satisfactory progress is being made with the development at the Ruth mine of the Nevada Consolidated Copper Co., now employing about eighty men underground. Reduced freight rates on coal were granted the Ely district this week. Road conditions are improving and shipments of ore will soon be resumed from the outside districts of Ward, Cherry Creek, and Hamilton, old producing districts of the White Pine boom period.

Mesabi Iron Co.'s Plant Ready To Start

Babbitt, Minn.—The units of the Mesabi Iron Co.'s concentractor are practically complete and are being tested as a whole. It is anticipated that the plant will be ready to make sinter by the middle of April.

Moving of Hibbing, Minn., Costs Over Million to Date

Hibbing—The cost to date to the Oliver Iron Mining Co. of moving of the village of Hibbing is $1,152,458. This sum covers the acquiring of surface rights, moving of the buildings from the old site, and improvements in the new town site. This expenditure will permit the mining of a large deposit of iron ore beneath the old site.

MICHIGAN

The Copper Country

C. & H. Producing on Limited Scale—Air Blasts in Quincy Mine—New Arcadian Lode Identified as Isle Royale Vein

BY M. W. YOUNGS

Houghton — Calumet & Hecla, Ahmeek, and Isle Royale, which resumed April 1, are producing on a limited scale. Rock taken out during course of shaft repairs in the conglomerate department of Calumet & Hecla is being shipped to the mill. It has not yet been determined at what rate production will be maintained from the conglomerate shafts, as this will depend on the size and efficiency of the force that can be built up, but it is probable that regular rock shipments will be brought up to 3,000 or 3,500 tons daily, equivalent to approximately 2,800,000 to 3,300,000 lb. of refined copper monthly. Ahmeek, it is expected, will produce at the start at the rate of 1,125,000 lb. per month and Isle Royale from 500,000 to 600,000 lb.

Thus far there has been no scarcity of labor, and no difficulty is expected in building up forces to the required number. Care is being exercised in the selection of men.

The Mineral Range railroad has opened its main line between Calumet and the Ahmeek mill preparatory to resumption of rock train service. Coal has been shipped. There has been no traffic over this line since mining operations were suspended a year ago.

An epidemic of grippe has affected employees of the mines as well as residents generally in the district, and at the Copper Range property the number incapacitated has affected production somewhat, there having been a falling off of rock shipments recently.

Several air blasts have occurred of late in old workings of the Quincy mine, no damage resulting to any of the present workings. These blasts are severely felt in Houghton and Hancock. Air blasts, however, have occurred with less frequency in the Quincy since the system of filling abandoned workings with waste rock has been practiced.

It has been definitely established that the lode that the New Arcadian is developing is the Isle Royale vein, it having been so pronounced by geologists who have studied its various characteristics and courses. The rich showing in the new north drift at the 1,100 or bottom level of the New Baltic shaft, now in 150 ft., continues. The rock is heavily shot with copper, and considerable small mass is present in the deposits. This drift will be continued as long as copper values persist. The copper zone appears to swing to the north, all openings in that direction being in uniformly rich ground. Work continues in the south drift from the 942 level. Four drills are now at work in the property.

At Seneca, good progress is being made with construction work at No. 2 shaft, Gratiot.

Gogebic Range

Tax Commission May Ask Law To Limit Expenditures of Local Governments

Ironwood—The Michigan State Tax Commission is considering the question of asking for a state law such as Minnesota has, limiting the per-capita expenditures of local governments to reasonable figure. In several villages, towns, and cities the total property valuation is exceedingly high owing to the presence of mines, and the local governments are inclined to be extravagant in their expenditures, because the mines bear the burden. In the past, Michigan communities have been far more reasonable on this question than those in Minnesota, but some are now turning to extravagance. It is believed by some that taxation in the Michigan mining districts is none too equitable, as mining property is assessed at as near 100 per cent of its cash value as the Tax Commission can determine from examining the mines and their books, whereas other real property is assessed by local assessors at from 20 per cent to 65 per cent of its cash value, and personal property is not assessed at all.

At the Pabst mine the necessary development work has been started at "G" shaft preparatory to starting the removal of "C" shaft pillar.

The North-Western Ry. is preparing to move 4,000,000 tons of ore from the Gogebic range this season, which is as much as the average for the last eight or ten years. The railroad officials have usually made a good forecast of the season's shipments, and local mining men are consequently feeling optimistic over the outlook. So far, the establishment of ore prices for the ensuing season has been delayed, awaiting developments in the freight-rate situation. The reduction in dock to furnace rates has led to the expectation of a similar reduction at the upper end of the Lakes.

MINNESOTA

Mesabi Range

York Mine Pushing Preparations to Mine—Mesabi Iron Co. to Make Sinter Soon

Coleraine—The workings of the Oliver company's Holman mine have been dewatered following the recent fire and consequent flooding.

Marble—The stripping operations at the Mesaba Cliffs Hill Trumbull property are to be resumed soon by A. Guthrie & Co., who have the contract.

The removal from the pit and stockpiling of the rocky cretaceous material at the Interstate Iron Co.'s Hill-Annex pit is progressing well. This material will be rehandled through the new screening plant.

Nashwauk—Preparations for mining at the Coates & Tweed Co.'s York mine are being pushed to the fullest extent. It is anticipated that the property will be among the first shippers of the season.

The Situation at the Mines in March

Important Copper Producers Running or Preparing To Do So, With Few Exceptions—Birmingham Active; Lake Superior District Quiet —Economic Conditions Little Changed

By A. H. Hubbell
News Editor, *Engineering and Mining Journal-Press*

MARCH saw the end of the period of widespread stagnancy that had prevailed in the copper industry since last spring, though conditions were still far from normal. By the end of the month the Jackling group of porphyries and the Calumet & Hecla and two of its subsidiaries were on the point of resuming production, actually starting April 1. Gradually increasing activity was shown by those other companies that had already resumed since the first of the year. United Verde, though active in construction work, gave no indication of resuming production; likewise the Phelps Dodge branches at Tyrone and Clifton-Morenci. With few other exceptions practically all important producers in the country were running, most of them at less than capacity.

In general, economic conditions throughout the country were unchanged from February. Except in isolated instances, wages, freight rates, and costs of supplies were about the same. The labor supply was a little better in some places. In others, unemployment was less evident.

In the Butte district, where operations were first resumed, about 8,600 men were employed during the month, Anaconda having 6,000, Butte & Superior 900, the Clark properties 600, and East Butte 400. These statistics indicate that operations were 60 per cent of normal. At Great Falls and Anaconda about 3,000 more men were working. The number of unemployed that recently flocked to Butte showed a lessening, owing to the approach of spring and resumption by small operators.

Production of refined copper in northern Michigan in March was 8,000,000 lb., a slight decrease from February and about 36 per cent of normal. Eleven furnaces were in operation, seven at Calumet & Hecla, one at Quincy, and three at the Michigan smelter.

Continued improvement was also visible in the iron-making industry in the Birmingham district, Alabama. At the end of the month, seventeen out of thirty-nine furnaces were active. Iron-ore production can only be approximated until reserve stocks are further reduced. In the Lake Superior iron country, on the other hand, there was little change from the stagnancy of the last few months. A few properties resumed work on a limited scale. Some ran simply to furnish employment. Ore prices for the current year had not been set.

Cold weather in the Pacific Northwest delayed the resumption of work at many of the remote and smaller properties, though affecting the larger operators but little. Granby suffered slightly from water shortage. The Tacoma, Trail, and Bunker Hill smelters continued in operation. Northport remained shut down. The Consolidated announced a decrease in the penalty on zinc in ores.

In the Cœur d'Alenes, the Bunker Hill, Federal, and Hecla companies, the only producers, extracted 6,000, 5,000, and 3,500 tons, respectively, of shipping ore, these being normal tonnages. The Bunker Hill smelter ran only one furnace most of the month. There was no surplus labor, though enough for the demand. Washington and Oregon operations, comparatively of a minor nature, were unchanged.

Placer and lode mining and dredging for gold in California progressed as of late. Grass Valley and various Mother Lode companies were active. The Shasta copper belt was dead. In Plumas County, the Engels company ran as usual. The Randsburg silver district was busy.

Gold miners in the Oatman district, Arizona, after the recent boom, settled down to a period of waiting until results of core drilling now progressing should be known and justify their hopes. Activity increased in the district tributary to Douglas.

In Nevada, conditions were normal. At Tonopah, bullion shipments ran over $600,000. Here the West End company increased its mine tonnage to 300 daily and took over the MacNamara mill on an operating basis. At Virginia City, the United Comstock completed its haulage tunnel and increased its construction crew 30 per cent, employing 750 men. Simon Silver-Lead's operations, near Mina, again were normal after the recent labor strike. At Goldfield, promising ore was cut in the Silver Pick lease. The Round Mountain companies ran as usual. Ely was quiet but Pioche showed some improvement.

Poor hauling conditions and the small shipper being out of the market accounted for decreased custom shipments to the Salt Lake Valley smelters in March. Murray ran three furnaces on lead, crowding through a large tonnage; Midvale ran three on lead and one on matte; and Garfield (normally copper) two reverberatories and one blast furnace, chiefly on siliceous silver ores. The International smelter at Tooele prepared to resume. Utah Apex, at Bingham, resumed work March 27. Utah Copper prepared to start. Bingham's output was about 12,000 tons (15,000 in February), the loss being due to railway trestle repairs. Park City produced 10,723 tons in the first four weeks (9,988 in February). Tintic's production in four weeks was 26,647 tons (27,122 in February).

Likewise in Colorado smelter receipts fell off owing to impassable wagon roads. Cripple Creek operators reduced wages to those paid elsewhere in the state. Enlargement of the Portland mill was begun to permit treatment of 1,200 tons daily of dump ore and stope filling averaging under $5 per ton. At Silver Plume, the East Butte company was pushing construction of a 400-ton plant to treat ore from the Dives Pelican group.

In the Black Hills, the labor situation was better, with fewer idle. The Homestake and Trojan companies remained the only producers, with operations on a par with those in February, both working at capacity. Smaller companies were less active.

In the Joplin-Miami district, conditions showed little change. About seventy-five mills ran, the number increasing to eighty-one at the end of the month. Production was about 7,200 tons weekly (5,800 in 1914). One mill burned.

Operations in the southeast Missouri lead district continued at about two-thirds of normal. One company claimed that owing to increased efficiency its output was normal, although operations were somewhat curtailed. Zinc operations in the Mascot district, in Tennessee, continued at about a third of normal.

Two zinc-ore producers resumed in the Wisconsin zinc district, making six in all—namely, the Dale, Connecting Link, Big Dick, Nightengale, North Unity, and Paquette. One roaster, one acid plant, and one oxide plant were also active. Four companies resumed buying blende. The month's production is estimated at 2,500 tons of crude blende concentrates; 1,000 tons of roasted blende, and 250 tons of lead ore as in recent months. An increase in output in April was predicted. Production in March was about 19 per cent of normal.

In Ontario, Porcupine's output increased largely, owing to richer Dome ore. McIntyre began building a new mill. Hollinger ran at capacity. More men were employed in the district. A new hydro-electric power development was begun. Cobalt's production was normal and Kirkland's slightly increased. The Tough-Oakes mill was almost ready to start. Conditions were unchanged in the Sudbury nickel district, with the Mond company the only producer. Labor, in general, was fairly plentiful.

THE MARKET REPORT

Daily Prices of Metals

Mar.	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
30	12.375@12.50	28.375	29.00	4.75@4.80	4.50	4.675
31	12.375	28.375	29.00	4.80	4.50	4.675
Apr. 1	12.375	28.375	29.00	4 80@4.85	4.55	4.70
3	12.375	28.75	29.375	4.80@4.90	4.625@4.70	4.70@4.75
4	12.25@12.375	28.75	29.50	4.90	4.625@4.70	4.75
5	12.25@12.375	28.75	29.50	4.90	4.65 @4.70	4.80

*These prices correspond to the following quotations for copper delivered: March 30th, 12.625 @ 12.75c.; 31st, April 1st and 3d, 12.625c.; 4th, 5th, 12.50 @ 12.625c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Mar.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
30	57 7/8	58 5/8	64	143	144 1/2	21 7/8	21 3/4	25 5/8	25 3/4
31	57 5/8	58 3/8	63 1/2	142 1/4	143 3/4	22	21 1/2	25 3/4	25 3/4
Apr. 1	...	...	...	...	...	...	...	...	...
3	57 1/8	57 7/8	62 1/2	143 3/8	144 7/8	21 3/4	21 3/4	25 5/8	25 3/4
4	57 1/8	57 7/8	62 1/2	143 5/8	145 1/8	21 3/4	21 1/4	25 5/8	25 3/4
5	58 1/8	58 3/4	62 1/2	143 7/8	145 1/2	21 7/8	21 3/8	26	26

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	Apr.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
30	436 3/4	99 5/8	65 3/4	33 7/8	3	438 1/2	99 1/8	65 1/2	33 3/4
31	437	99 5/8	66 1/8	34 1/8	4	439 3/4	99 3/8	65 1/2	33 1/2
Apr. 1	437	99 5/8	65 5/8	33 7/8	5	439 1/2	99 1/8	65 7/8	33 1/2

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Average Metal Prices for March

Copper:	
New York Electrolytic	12.567
London Standard	59.245
London Electrolytic	65.739
Lead:	
New York	4.720
St. Louis	4.421
London	21.266
Silver:	
New York, foreign	64.440
New York, domestic	99.625
London	33.269
Sterling Exchange	436.912
Zinc:	
St. Louis	4.658
London	25.467
Tin:	
99 per cent	28.426
Straits	29.171
London	143.152
Antimony	4.319
Quicksilver	50.204
Platinum	87.500

Metal Markets

New York, April 5, 1922

The week has been marked by a phenomenal demand for lead, with an attendent price increase. Zinc is also stronger, and tin has been firm. Copper is again weaker. Business as a whole continues to improve, and better industrial conditions are being discounted by the stock market, which has advanced steadily for some months.

Copper

Inspired by the highly satisfactory sales for the month of March, the larger producers are not disposed to shade their price of 12.75c. delivered, and feel that the market will react to this level as soon as buying of importance develops. Meanwhile smaller producers are marketing their metal for whatever it will bring. Copper has been freely offered all week at 12⅝c. delivered, and certain interests have gone below this price. It is a mistake to think that the tonnage offered at the lower range of prices is small, for individual orders of up to 2,000 tons have been placed at marked concessions and for delivery as late as August. April delivery is rarely wanted. Without doubt, the resumption of the porphyries on April 1 has had a bad effect on prices, but the reopening was justified, for all of the free copper held by those interests is reported to have been sold.

Export business has been fairly active, but at increased concessions in price, the effort to hold the foreign market above domestic levels evidently having been abandoned.

Lead

The American Smelting & Refining Co., after holding the official contract price of New York at 4.70c. since Sept. 22, increased it to 4.80c. on Thursday, March 30, and to 4.90c. on Monday, April 3. Desilverized lead in St. Louis was quoted at 20 points under these figures.

The increased prices have brought out a flood of inquiries, which have virtually scared some producers off the market. Some large orders have been placed, and much more business could have been done had lead been in freer supply. By this it must not be inferred that there is any scarcity of the metal, for comparatively large stocks of high-cost lead are available, and it is likely that some of these will be marketed at not much above current prices. Chemical lead is about on a level with the desilverized product now, though the 5-point range in our St. Louis price may indicate that difference between the two grades.

Zinc

An improved demand from galvanizers enabled producers to do a better business in zinc than for many weeks. Prices rose steadily, and the general holding level today is 4.80c. in a firm market. A feature of the business has been the predominance of sales for forward delivery, practically all of which were made at a premium of 5 points per month in advance of April shipments. The New York price continues at an advance of 35 points over the St. Louis

price. High-grade zinc has been sold at unchanged prices of 6c. with freight allowed.

Tin

Demand has continued satisfactory, though the market was not quite so active as last week. The price is slightly firmer. London has changed little, but sterling has advanced. Statistics compiled by the New York Metal Exchange show domestic consumption during March at 6,030 long tons, compared with 3,215 long tons in February. Stocks in this country on March 31, 3,086 long tons, compared with 1,406 on Feb. 28. It is rumored, however, that some metal has accumulated in unlicensed warehouses which has been included in consumption. Tin for forward delivery has commanded approximately the same prices as for spot.

Arrivals of tin, in long tons: Total for March, 7,710; April 1, Straits, 1,875; Liverpool, 25; China, 50; 3d, London, 25.

Gold

Gold in London: March 30th, 95s. 3d.; 31st, 95s.; April 3d, 95s.; 4th, 94s. 9d.; 5th, 94s. 9d.

Foreign Exchange

The market has been quiet throughout the week, with narrow price changes but with a firm tendency. On Tuesday, April 4, francs were 9.14c.; lire, 5.30c.; marks, 0.3125c.; and Canadian dollars, 97.125c.

Silver

Silver prices reached the peak of the recent rise on March 31. After that date China turned seller, having previously been a heavy buyer, and the Indian bazaars also sold. These sales caused a reaction in both London and New York; prices falling to 33⅛d. and 65⅛c. respectively. From this figure the New York market improved quickly on account of short supplies of spot silver and because sellers were holding for prices above the London parity.

Mexican Dollars—March 30th, 50¼; 31st, 50⅜; April 1st, 50¼; 3d, 50⅜; 4th, 50; 5th, 50¼.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17.50@18.50c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4.50c.; market quiet and firm. W.C.C. brand, 5@5¼c. per lb. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—7c. per lb.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Cobalt — Metal, $3@$3.25 per lb., black oxide, $2 per lb. in bbls.

Iridium—Nominal, $150@$170 per oz.

[1]**Molybdenum Metal**—In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Standard prices reduced April 1. Outside market quiet at 30@33c. per lb.

Monel Metal—Shot, 32c.; blocks, 32c. per lb., f.o.b. Bayonne. Demand improving.

Osmium—$70 per troy oz. Nominal. $70, Los Angeles, Cal.

Palladium—Nominal, $55@$60 per oz.

Platinum—$85@$90 per oz.

Quicksilver—$50 per 75-lb. flask. San Francisco wires $50. Firm.

[1]**Rhodium**—$100@$115 per troy oz.

[1]**Selenium**—Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $18@$20 per lb.

[1]**Tungsten Metal**—Wire, $35@$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Basis 48 per cent Cr_2O_3, 40@45c. per unit, c.i.f. North Atlantic ports. Market quiet.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore—F.o.b. Port Henry N. Y.: Old bed 21 furnace, $4.85; old bed concentrates, 63 per cent, $5.75; Harmony, cobbed, 63 per cent, $5.75; new bed low phosphorus, 65 per cent, $8.50.

Manganese Ore—25½@26c. per unit, seaport; chemical ore, $45@$60 per gross ton, lump. Nominal.

Molybdenum Ore—85 per cent MoS_2, 40@45c. per lb. of contained sulphide, New York. Quotation purely nominal.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots. Nominal.

[1]**Titanium Ores**—Ilmenite 52 per cent TiO_2, 1½@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Bolivian, 60 per cent WO_3 and over, per unit of WO_3, $3, f.o.b. Atlantic ports. Chinese, as low as $1.85@$2. Nominal.

Uranium Ore (Carnotite) —Ore containing 1½ per cent U_3O_8 and 5 per cent V_2O_5 sells for $1.50 per lb. of U_3O_8 and 75c. per lb. of V_2O_5; ore containing 2 per cent U_3O_8 and 5 per cent V_2O_5 sells for $2.25 and 75c. per lb., respectively; higher U_3O_8 and V_2O_5 content commands proportionately higher prices.

Vanadium Ore—$1 per lb. of V_2O_5 (guaranteed minimum of 18 per cent V_2O_5), New York. Nominal.

Zircon — Zirconium silicate, f.o.b. Pablo, Fla., 4½@13c. per lb.

[1]**Zirkite**—According to conditions, $70@$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

[1]Furnished by Foote Mineral Co., Philadelphia, Pa.

Zinc and Lead Ore Markets

Joplin, Mo., April 1—Zinc blende, per ton, high, $29.70; basis 60 per cent zinc, premium, $28; Prime Western, $27; fines and slimes, $26@$25; average settling price, all grades of blende, $26.76.

Lead, high, $65.75; basis 80 per cent lead, $65; average settling price, all grades of lead, $63.60 per ton.

Shipments for the week: Blende, 6,803; lead, 2,343 tons. Value, all ores the week, $331,020.

The largest single week's purchase of blende for two years was made this week, amounting to 14,640 tons. It is more than double the average weekly purchases of March, or the average for the three months. Early in the week an effort was made among buyers to lower the market, but sellers declined to accept. Buying did not become active until the afternoon of Friday, and was continued all day today, with prospects that another 5,000-ton purchase would be made late today.

Lead continues to climb surprisingly in price, with the demand growing stronger week after week. The Eagle Picher Company is now requiring a large tonnage to supply its factory, operating at full capacity manufacturing lead pipe and other plumbers' lead supplies. Federal Lead is seeking a heavy tonnage in this field since December, the first time it has ever been a factor in the local lead situation.

Platteville, Wis., April 1—Blende, basis 60 per cent zinc, $29. Lead ore, $65 per ton. Shipments for the week: Blende, 656; lead, 40 tons. Shipments for the year: Blende, 3,322; lead, 641 tons. Shipped during the week to separating plants, 569 tons blende.

Non-Metallic Minerals

Asbestos — Crude No. 1, $900@$1,100; No. 2, $500@$750; long spinning fibers, $300@$450; spinning fibers, $200@$250; magnesia and compressed sheet fibers, $100@$175; shingle stock, $70@$110; paper stock, $35@$45; cement stock, $15@$17.50; shorts, $6@$10; all per short ton, f.o.b. Thetford, Broughton, and Black Lake mines. Market quiet.

Barytes—Crude, $8 per ton, f.o.b. mines. Ground white, $23, f.o.b. mills. Off-color grades, $15@$20, f.o.b. Southern mills. Foreign barytes, c.i.f. New York, $7.80@$8.25 per ton crude.

Bauxite — American, crushed and dried, $6@$8 per gross ton; pulverized and dried, $12@$14 per gross ton; calcined, $20@$22 per gross ton, all f.o.b. shipping points. Foreign bauxite offered at $6@$8 per metric ton, c.i.f Atlantic ports, depending upon grade.

Borax—Granulated, crystals or powdered, in bags, carloads, 5¼c. per lb.; in bbls. 5½c.

Chalk—English, extra light, 5c. Domestic light, 4¼@4½c.; heavy, 3½@3¾c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, $6@$8; washed, $8@$9; powdered, $12@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $13@$20, f.o.b. Virginia points. Imported lump, $14@$20, f.o.b. American ports; powdered, $35@$45, f.o.b., quoted at New York.

Emery—Turkish emery, 6c. per lb. American, 4c. Inferior grades, 3½c., f.o.b. from New England points.

Feldspar—No. 1 pottery grade, $6.50@$6.85 per long ton; No. 2 pottery, $5.75; No. 1 soap grade, $7, f.o.b. cars. No. 1 Canadian, $22@$23, f.o.b. mill. High potash Canadian, $10 per ton, f.o.b. mines.

Fluorspar — Lump, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20 per ton; gravel, $17.50. No. 1 ground, $50@$55, f.o.b. Illinois and Kentucky mines. Lump, $12.50@$13.50; ground, 95@96 per cent, $25@$26, f.o.b. New Mexico.

Fuller's Earth—16 to 30 mesh, $20 per ton; 30 to 60 mesh, $20; 60 to 100 mesh, $17; 100 mesh and over, $15, f.o.b. Pennsylvania points. English, $23@$25, f.o.b. New York.

Graphite—Ceylon lump, first quality, 5@7c.; chip, 4@5½c.; dust, 2½@4c. per lb.; No. 1 flake, 6@8c.; amorphous crude, $18@$45 per ton. All f.o.b. New York.

Gypsum — Crushed rock, $3@$4.50 per ton, depending upon shipping point. Ground, $4, f.o.b. shipping point.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. size, $1.25@$1.75 per net ton; 1½ in., $1@$1.25. Prices for other sizes practically the same. Agricultural limestone, $2.50@$3.75 per net ton, f.o.b. eastern shipping points, depending upon analysis.

Magnesite—Crude, $8@$12 per ton. High-grade caustic calcined, lump form, $30@$40 per ton. Plastic calcined, $45@$50 in bbls., carload lots, f.o.b. California points. Atlantic seaboard, $60.

Dead-Burned — $33 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $28 per ton, f.o.b. Baltimore. (Magnesite brick — See Refractories.)

Mica — India block mica, slightly stained, per lb.; No. 6, 35c.; No. 5, $1.25; No. 4, $2.25; No. 3, $2.90; No. 2, $4; No. 1, $5.20. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4, $3; No. 3, $4.75; No. 2, $6; No. 1, $7.50; A1, $9; ground, wallpaper grade, $90@$200 per ton (depending upon quantity); ground roofing mica, $25@$70, all f.o.b. New York. Water-ground mica, 100 and 160 mesh, 6½c. per lb., f.o.b. Virginia points.

Monazite—Minimum of 6 per cent thorium oxide, $30 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports, pebble grade: 77 per cent tricalcium phosphate, $8.50 (9.50 for hard rock); 75 per cent, $7; 75@74 per cent, $6.50; 70 per cent, $4.75; 68 per cent, $4.25; 68@66 per cent, $4.

Pumice Stone—Imported, lump, 3@40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 12c., c.i.f. Atlantic seaports; furnace size, 13c.; Spanish lump, 13@14c.; domestic fines, f.o.b. mines, Georgia, 11@12c.

Silica—Glass sand, $1.25@$2.25 per ton; sand-blast material, $2.25@$4.50, f.o.b. Indiana and Illinois points. Amorphous or decomposed variety, soft silica, 250 mesh, $16; 350 mesh, $20; 450 mesh, $35 per ton. Ganister, crude, $2.50 per ton, f.o.b. Illinois points. Molding sand, building sand, glass sand, $2@$3, f.o.b. Pennsylvania points.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—20 to 200 mesh, $7@$12 per ton, f.o.b. Vermont; $7.50@$12, f.o.b. points in Georgia; 200 mesh, $16@$26, f.o.b. Los Angeles.

Mineral Products

Copper Sulphate — Large crystals, 5.40c.; small crystals, 5.30c. per lb., f.o.b. New York.

Potassium Sulphate — Powder, domestic, $1 per unit, basis 90 per cent, f.o.b. New York.

Sodium Nitrate—$2.85 per 100 lb., ex vessel, Atlantic ports.

Sodium Sulphate—For 95 per cent material, $12.50 per ton, f.o.b. in bulk, Western mines, spot and six months' contract; $17@$20 per ton, New York.

Ferro-Alloys

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., $12@$15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 11c. per lb. of chromium contained; 4 to 6 per cent carbon, 12c., f.o.b. works.

Ferromanganese—Domestic, 78 to 82 per cent, $62@$64, f.o.b. furnace; English, $62.50, c.i.f. Atlantic seaport. Spiegeleisen, 16@19 per cent, $29 per gross ton, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2 per lb. of contained metal, f.o.b. works. Imported material, $1.70@$2.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $38@$40; 50 per cent, $54@$55; 75 per cent, $115@$120.

Ferrotungsten—Domestic, 70 to 80 per cent W, 37@45c. per lb. of contained tungsten, f.o.b. works. Foreign, 50c., duty paid, f.o.b. Atlantic ports.

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—$3.55 per lb. of V. contained.

Metal Products

Copper Sheets—Current New York list price, 20.25c. per lb.; wire, 14@14.125c.

Lead Sheets—Full lead sheets, 7¾c.; cut lead sheets, 8c. in quantity, mill lots.

Nickel Silver—26.75c. per lb. for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 17.25c.; sheathing, 16.75c.; rods, ⅜ to 3 in., 14.25c.

Zinc Sheets—$7.50 per 100 lb. less 8 per cent on carload lots, f.o.b. works.

Refractories

Bauxite Brick—56 per cent alumina, $130 per 1,000; 76 per cent, Suprafrax, $200 per 1,000; f.o.b. works, St. Louis and Pittsburgh.

Chrome Brick—$40 per net ton.

Chrome Cement — 40@45 per cent Cr_2O_3, $30@$32 per net ton, and $31 in sacks, carload lots, f.o.b. eastern shipping points.

Firebrick—First quality, 9-in. shapes, $32@$35 per 1,000, Pennsylvania, Ohio and Kentucky.

Magnesite Brick—9-in., straights, $45 per net ton, f.o.b. works.

Silica Brick—9-in., per 1,000, $30@$35 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, April 4, 1922

The coal strike has had no untoward influence upon the iron and steel trade so far. The closing of union mines is complete. Mills are well stocked with steam, gas, and byproduct coal.

Bars and shapes present a general market of 1.50c., an advance of $2 a ton in the last ten days and $3 a ton from the recent low point. In sheets the mills, instead of stiffening quotations, gradually announced that they intended to put prices up $3 a ton on April 1 or thereabouts, and these announcements produced an active buying movement. The American Sheet & Tin Plate Co. at this writing has not advanced its prices, but is expected to do so without previous notice.

Steel-ingot production has undergone a further advance, and is now at 31,000,000 or 32,000,000 tons a year, against a 29,000,000 ton rate at the end of February.

Pig Iron—Producers occupy a much firmer attitude and expect to be able to work prices up a trifle. The market is firm at $19.50 for Bessemer, $18 for basic and $19 for foundry, f.o.b. Valley furnaces, freight to Pittsburgh being $1.96. The Snyder averages for March, at Valley furnaces, were $19.388 for Bessemer and $18 for basic.

Coke

Connellsville—Furnace, $3.25@$3.50; foundry, $4.25@$4.75.

[1]Foote Mineral Co., Philadelphia, Pa.

COMPANY REPORTS

Hollinger Consolidated Gold Mines, Ltd.

A report of operations of Hollinger Consolidated Gold Mines, Ltd., for 1921 shows a net profit of $5,091,659.62, of which $3,198,000 was appropriated for dividends. Profit-and-loss statement follows:

PROFIT-AND-LOSS STATEMENT FOR YEAR 1921

Gold and silver produced		$10,031,050.57
Interest on investments and other income		283,464.74
		$10,314,515.31
Disposal of 1921 income		
General charges	$459,827.79	
Mining charges	3,194,844.44	
Milling charges	1,568,183.46	
		5,222,855.69
Operating profit		$5,091,659.62
Deduct		
Taxes, Province of Ontario	$76,042.54	
Municipal taxes	49,102.22	
Dominion of Canada 1921 taxes	205,000.00	
Balance of 1919 and 1920, taxes	99,744.85	
	$429,889.61	
Depreciation		
Plant	627,488.50	
Investment in other companies and properties written down	3,551.82	
Donations	3,802.20	
		1,064,732.13
Net profit		$4,026,927.49
Paid out in dividends		3,198,000.00
Added to surplus		$828,927.49

BALANCE SHEET, DEC. 31, 1921

ASSETS

Capital		
Mining properties		$21,150,244.17
Plant, brought forward from 1920	$1,500,000.00	
Additions during 1921	482,790.79	
	$1,982,790.79	
Less depreciation for 1921	672,488.50	
		1,355,302.29
Investments in other companies and properties:		
Brought forward from 1920	$40,002.00	
Additions during 1921	8,472.32	
	$48,474.32	
Less written off in 1921	3,551.82	
		44,922.50
		$22,550,468.96
Current assets		6,042,794.46
Bullion in transit		454,225.31
Solutions and slag on hand		99,040.47
		$29,146,529.20

LIABILITIES

Capital stock		
Authorized	$25,000,000.00	
In treasury	400,000.00	
		$24,600,000.00
Current liabilities		
Wages unpaid	$135,575.72	
Accounts payable	245,173.98	
		380,749.70
Reserves for Dominion of Canada 1921 taxes		205,000.00
Surplus		
Balance of account from 1920	$3,131,852.01	
Profits from Jan. 1 to Dec. 31, 1921	4,761,514.86	
	$7,893,366.87	
Less dividends	$3,198,000.00	
Plant depreciation	627,488.50	
Donations	3,802.20	
Balance 1919 and 1920 taxes paid in 1921	99,744.85	
Investments in other companies and properties written down	3,551.82	
	$3,932,587.37	
		3,960,779.50
Net surplus		$29,146,529.20

Total tonnage milled was 1,072,493 tons; average value per ton, $9.67; net value recovered, $10,031,050.57. General charges were $0.429 per ton; mining, $2.979; milling, $1.462; total, $4.870. Ore reserves are given as 1,571,980 tons at $12.80 per ton; 1,653,969 tons at $9.15 per ton, and 176,661 tons at $7.80, making a total gross value of $36,644,154.

United States Steel Corporation

A combined report of the operations and affairs of the United States Steel Corporation and subsidiary companies for 1921, together with a statement of the condition of the finances and property at the close of that year, follows:

INCOME ACCOUNT

The total earnings were, after deducting all expenses incident to operations, including ordinary repairs and maintenance (approximately $92,000,000) and taxes (including reserves for Federal income taxes), per general profit and loss account		$100,791,279.50
Less, interest on outstanding bonds, mortgages and purchase money obligations of the subsidiary companies		8,065,221.58
Balance of earnings in the year 1921		$92,726,057.92
Less charges and allowance for depletion and depreciation applied as follows, viz.:		
To depreciation and replacement fund and sinking funds on bonds of subsidiary companies	$27,905,045.44	
To sinking funds on bonds of U. S. Steel Corporation	8,863,180.35	
		36,768,225.79
Net income in the year 1921		$55,957,832.13
Deduct		
Interest on U. S. Steel Corporation bonds, outstanding, viz.:		
Fifty-year 5 per cent gold bonds	$11,037,432.49	
Ten to sixty-year 5 per cent gold bonds	8,642,150.00	
	$19,679,582.49	
Premium paid on bonds redeemed	747,461.96	
		20,427,044.45
Balance carried forward		$35,530,787.68
Add: Net balance of sundry charges and credits, including adjustments of various accounts		1,086,229.51
Balance		$36,617,017.19
Dividends for the year 1921 on U. S. Steel Corporation stocks, viz.:		
Preferred, 7 per cent	$25,219,677.00	
Common, 5 per cent	25,415,125.00	
		50,634,802.00
Balance provided from undivided surplus		$14,017,784.81

UNDIVIDED SURPLUS OF UNITED STATES STEEL CORPORATION AND SUBSIDIARY COMPANIES

Since April 1, 1901

Surplus or working capital provided in organization		$25,000,000.00
Balance of surplus accumulated by all companies from April 1, 1901, to Dec. 31, 1920, exclusive of subsidiary companies' inter-company profits in inventories, per annual report for year 1920	$498,454,890.89	
Less, for the following items, viz.:		
Adjustment of previous years' allowances for depreciation and of other accounts, not applicable to 1921 operations	510,148.49	
Provision for undivided surplus for excess of dividends over income for year 1921, as above	14,017,784.81	
		$483,926,957.59
Total undivided surplus, Dec. 31, 1921, exclusive of profits earned by subsidiary companies on inter-company sales of products on hand in inventories at that date (see note below)		$508,926,957.59

Note: Surplus of subsidiary companies amounting to $32,114,777.56 and representing profits accrued on sales of materials and products to other subsidiary companies which are in latters' inventories Dec. 31, 1921, is deducted from the amount of inventories included under Current Assets in Consolidated General Balance Sheet.

Superior Copper Co.

A report of operations of the Superior Copper Co. for 1921 states that no copper was produced during the year. Copper sold amounted to 246,009 lb., at 12.64c. per lb., incurring a loss of $2,497.46. Loss for the year was $1,915.22. Balance of current assets on Dec. 31, 1920, was $390,084.07; and on Dec. 31, 1921, $388,168.85.

Bohemia Mining Co.

A report of operations of the Bohemia Mining Co. for the year ending Feb. 28, 1922, states that cash receipts amounted to $16,186.16 and disbursements to $8,116.91.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1921	1922	1921	1922	1921	1922
January	65.950	65.450	39.985	35.035	372.650	421.750
February	59.233	65.290	34.745	33.891	385.932	435.511
March	56.023	64.440	32.479	33.269	389.806	436.912
April	59.337	.....	34.250	.....	391.784	.....
May	59.810	.....	34.165	.....	396.580	.....
June	58.510	.....	34.971	.....	377.236	.....
July	60.260	.....	37.481	.....	362.565	.....
August	61.597	.....	38.096	.....	364.505	.....
September	66.160	.....	40.082	.....	371.725	.....
October	70.970	.....	41.442	.....	386.315	.....
November	68.234	.....	38.750	.....	396.315	.....
December	65.760	.....	35.645	.....	414.880	.....
Year	62.654	.....	36.841	.....	384.191	.....

New York quotations cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1921	1922	1921	1922	1921	1922
January	12.597	13.465	70.964	65.226	79.119	72.321
February	12.556	12.864	70.925	60.250	75.925	66.125
March	11.976	12.567	67.565	59.245	71.190	65.739
April	12.438	.....	69.381	.....	71.786	.....
May	12.742	.....	73.196	.....	74.298	.....
June	12.697	.....	71.852	.....	75.682	.....
July	12.170	.....	71.155	.....	75.286	.....
August	11.634	.....	68.614	.....	72.705	.....
September	11.948	.....	67.977	.....	72.295	.....
October	12.673	.....	67.327	.....	73.476	.....
November	13.035	.....	66.614	.....	74.386	.....
December	13.555	.....	66.706	.....	74.525	.....
Year	12.502	.....	69.356	.....	74.223	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1921	1922	1921	1922	1921	1922
January	4.821	4.700	4.747	4.388	23.387	23.667
February	4.373	4.700	4.228	4.396	20.650	20.681
March	4.084	4.720	4.000	4.421	18.911	21.266
April	4.356	.....	4.272	.....	20.589	.....
May	4.952	.....	4.784	.....	23.399	.....
June	4.485	.....	4.293	.....	22.563	.....
July	4.410	.....	4.260	.....	23.399	.....
August	4.382	.....	4.217	.....	23.489	.....
September	4.600	.....	4.392	.....	23.148	.....
October	4.690	.....	4.439	.....	23.679	.....
November	4.683	.....	4.356	.....	24.483	.....
December	4.700	.....	4.369	.....	25.322	.....
Year	4.545	.....	4.363	.....	22.752	.....

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1921	1922	1921	1922	1921	1922
January	31.470	31.480	36.000	32.100	190.464	163.065
February	28.534	29.835	32.142	30.767	166.250	149.850
March	27.296	28.426	28.806	29.171	156.024	143.152
April	28.990	.....	30.404	.....	163.905	.....
May	31.431	.....	32.500	.....	177.411	.....
June	28.514	.....	29.423	.....	167.506	.....
July	26.755	.....	27.655	.....	164.530	.....
August	25.662	.....	26.301	.....	155.318	.....
September	26.280	.....	26.680	.....	156.750	.....
October	27.278	.....	27.655	.....	156.380	.....
November	28.592	.....	28.935	.....	158.898	.....
December	32.106	.....	32.486	.....	169.738	.....
Year	28.576	.....	29.916	.....	165.265	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1921	1922	1921	1922
January	5.413	4.691	25.262	26.321
February	4.928	4.485	24.850	24.213
March	4.737	4.658	25.077	25.467
April	4.747	.....	25.530	.....
May	4.848	.....	26.923	.....
June	4.421	.....	26.750	.....
July	4.239	.....	26.262	.....
August	4.186	.....	25.068	.....
September	4.235	.....	25.256	.....
October	4.605	.....	26.315	.....
November	4.667	.....	25.949	.....
December	4.835	.....	26.900	.....
Year	4.655	.....	25.845	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1921	1922	1921	1922	1921	1922
January	5.258	4.463	48.440	49.960	73.400	97.260
February	5.250	4.416	49.545	48.295	70.227	89.545
March	5.282	4.319	46.796	50.204	72.463	87.500
April	5.137	.....	45.423	.....	73.404	.....
May	5.250	.....	47.000	.....	73.740	.....
June	5.087	.....	46.846	.....	74.942	.....
July	4.735	.....	44.950	.....	70.440	.....
August	4.597	.....	45.028	.....	73.222	.....
September	4.564	.....	42.660	.....	75.960	.....
October	5.085	.....	39.840	.....	81.800	.....
November	4.734	.....	39.804	.....	82.609	.....
December	4.500	.....	49.212	.....	78.192	.....
Year	4.957	.....	45.462	.....	75.033	.....

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1921	1922	1921	1922	1921	1922
January	33.96	21.55	31.96	20.15	33.88	21.34
February	28.96	21.46	26.96	19.71	30.25	20.88
March	28.16	21.35	26.46	19.96	27.85	20.83
April	26.96	.....	24.46	.....	26.77	.....
May	26.21	.....	23.84	.....	25.56	.....
June	24.96	.....	22.66	.....	24.38	.....
July	22.84	.....	20.76	.....	22.36	.....
August	21.96	.....	20.29	.....	21.53	.....
September	21.96	.....	21.21	.....	22.82	.....
October	21.96	.....	20.96	.....	22.96	.....
November	21.96	.....	20.96	.....	22.74	.....
December	21.96	.....	20.65	.....	21.96	.....
Year	25.15	.....	23.43	.....	5.26	.....

In dollars per long ton.

Monthly Crude Copper Production

	1921		1922	
	November	December	January	February
Alaska shipments	4,841,506	8,881,013	6,909,383	4,193,357
Anaconda	(a)	(a)	(a)	9,503,000
Arizona Copper	(a)	(a)	(a)	(a)
Calumet & Arizona	(a)	(a)	(a)	2,462,000
Calumet & Hecla	(a)	(a)	(a)	(a)
Other Lake Superior	5,500,000	5,500,000	6,000,000	6,000,000
Chino	(a)	(a)	(a)	(a)
Con. Ariz. Smelting	(a)	(a)	(a)	(a)
East Butte	750,000	(a)	(b) 750,000	(a)
Inspiration	(a)	(a)	(a)	2,485,000
Magma	(a)	(a)	(a)	(a)
Miami	4,514,000	5,030,941	5,348,000	4,918,000
Nevada Cons.	(a)	(a)	(a)	(a)
New Cornelia	1,605,936	1,717,183	1,602,909	1,459,063
Old Dominion	(a)	(a)	(a)	(a)
Phelps Dodge	(a)	(a)	(a)	4,091,000
Ray	(a)	(a)	(a)	(a)
Shattuck Arizona	(a)	(a)	(a)	(a)
United Verde	(a)	(a)	(a)	(a)
United Verde Extension	(a)	(a)	(a)	646,110
Utah Copper	(a)	(a)	(a)	(a)
Others, estimated	11,130,000	8,500,000	11,400,000	10,200,000
Total United States	28,341,442	29,629,137	32,010,292	45,957,530
Imports: Ore and concentrates, matte	7,297,583	14,844,641	7,136,976	5,081,497
Imports of blister, unrefined	10,561,454	14,731,185	5,178,068	18,081,802
Imports of refined	2,139,144	2,447,925	565,439	.....
Grand total	49,339,623	61,652,888	44,890,775	69,120,829
Backus & Johnston	900,000	822,000	1,118,000	990,000
Boleo	976,815	954,765	1,102,080	954,765
Cananea	(a)	(a)	(a)	(a)
Cerro de Pasco	5,618,000	5,536,000	4,726,000	4,868,000
Chile	4,000,000	4,000,000	4,000,000	4,000,000
Cons. M. & S. of Canada	200,000	313,290	97,985	(a)
Falcon Mines	518,600	550,800	582,000	566,800
Furukawa	2,690,377	3,028,499	2,357,258	.....
Granby Cons.	2,365,017	2,215,403	1,974,162	955,038
Hampden Cloncurry	(a)	(a)	(a)	(a)
Katanga	5,984,370	6,570,900	6,772,600	5,785,920
Mount Morgan	(a)	(a)	(a)	(a)
Mount Lyell	1,068,000	782,000	.....	.....
Phelps Dodge Mexican	(a)	(a)	(a)	318,000
Sumitomo	2,910,964	2,732,392	1,439,488	3,089,353
Wallaroo & Moonta	835,760	954,795	122,575	.....

(a) No copper produced during this month. (b) Estimated.

Comparative Annual Copper Production

	1919	1920	1921	1922
January	135,733,511	121,903,744	90,596,597	32,010,292
February	111,649,512	117,540,000	86,682,941	47,417,530
March	102,040,460	120,309,316	91 046,345	.....
April	98,808,998	116,078,871	46,946,523	.....
May	92,652,975	114,964,207	25,310,511	.....
June	95,856,570	116,107,856	24,623,693	.....
July	100,369,247	109,729,610	22,033,739	.....
August	107,994,040	112,460,254	23,248,398	.....
September	108,703,075	104,919,562	23,855,316	.....
October	115,143,143	105,231,571	23,231,572	.....
November	117,289,735	106,700,178	28,341,442	.....
December	102,997,633	95,709,009	29,629,137	.....

MINING STOCKS

Week Ended April 1, 1922

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	65	61	61½	Sept. '20, Q	$0.50
Alaska-Br. Col. new.	N. Y. Curb	4	3¾	4	.....	....
Allouez	Boston	27	27	27	Mar. '19	1.00
Anaconda	New York	52	49⅝	51½	Nov. '20, Q	1.00
Arcadian Consol.	Boston	2⅜	2⅜	2⅜	.....	....
Ariz. Com'l	Boston	9½	9	9¼	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*21	*18	*20	.....	....
Bingham Mines	Boston	13½	13¼	13½	Sept. '19, Q	0.25
Calumet & Arizona	Boston	.....	.....	58	Mar. '22, Q	0.50
Calumet & Hecla	Boston	280	275	277	June '20, Q	5.00
Canada Copper	N. Y. Curb	*22	*22	*22	.....	....
Centennial	Boston	†12¼	†10	12	Dec. '18, SA	1.00
Cerro de Pasco	New York	36	34½	35¼	Mar. '21, Q	0.50
Chile Copper	New York	17⅞	16⅜	17⅜	.....	....
Chino	New York	28	26½	27⅝	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*32½	*31	*32	.....	....
Con. Arizona	N. Y. Curb	*2	*2	*2	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1 3/16	1¼	1 3/16	.....	....
Copper Range	Boston	43¾	42	43¼	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1⅜	*90	1 3/16	.....	....
Davis-Daly	Boston	7½	7	7¼	Mar. '20, Q	0.25
East Butte	Boston	11	10	10⅜	Dec. '19, A	0.50
First National	Boston Curb	*73	*70	*73	Feb. '19, SA	0.15
Franklin	Boston	1½	1½	1½	.....	....
Gadsden Copper	Boston Curb	*65	*65	*65	.....	....
Granby Consol.	New York	28	26½	28	May '19, Q	1.25
Greene-Cananea	New York	27½	26⅜	26⅜	Nov. '20, Q	0.50
Hancock	Boston	2½	2½	2½	.....	....
Howe Sound	N. Y. Curb	3⅛	2⅞	3	Jan. '21, Q	0.05
Inspiration Consol.	New York	40¼	39½	40¼	Oct. '20, Q	1.00
Iron Cap	Boston Curb	7½	7	7	Sept. '20, K	0.25
Isle Royale	Boston	24	23½	24	Sept. '19, SA	0.50
Kennecott	New York	30½	28⅜	29½	Dec. '20, Q	0.50
Keweenaw	Boston	†½	†½	½	.....	....
Lake Copper	Boston	2⅛	2⅛	2⅛	.....	....
La Salle	Boston	1¼	1¼	1¼	.....	....
Magma Copper	N. Y. Curb	29½	28⅜	29¼	Jan. '19, Q	0.50
Majestic	Boston Curb	†*12	*†8	*5	.....	....
Mason Valley	Boston	†2	†1½	1⅞	.....	....
Mass. Consolidated	Boston	2⅛	2⅛	2⅛	Nov. '17, Q	1.00
Miami Copper	New York	27⅝	27⅛	27¼	Feb. '22 Q	0.50
Michigan	Boston	†2½	†1¼	2	.....	....
Mohawk	Boston	58½	56	58	Feb. '22, Q	1.00
Mother Lode Coa	N. Y. Curb	8	7½	7⅞	.....	....
Nevada Consol.	New York	15¾	14⅜	15	Sept. '20, Q	0.25
New Cornelia	Boston	18	17½	17½	Feb. '22, K	0.25
North Butte	Boston	12¾	12	12⅜	Oct. '18, Q	0.25
North Lake	Boston	.....	.....	*10	.....	....
Ohio Copper	N. Y. Curb	*9	*9	*9	.....	....
Old Dominion	Boston	24¾	24½	24½	Dec. '18, Q	1.00
Osceola	Boston	34	34	34	June '20, Q	0.50
Phelps Dodge	Open Mar.	†170	†160	...	Jan. '22, Q	1.00
Quincy	Boston	44½	43	44	Mar. '20, Q	1.00
Ray Consolidated	New York	15¼	14⅛	14⅜	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*3	*2	*2	.....	....
St. Mary's Min. Ld.	Boston	47½	43¼	44½	Dec. '21, K	1.00
Seneca Copper	Boston	.....	.....	13¾	.....	....
Shannon	Boston	*90	*80	*85	Nov. '17, Q	0.25
Shattuck Arizona	New York	8¾	8¼	8¾	Jan. '20, Q	0.25
South Lake	Boston	†1.00	†*65	*80	.....	....
Superior & Boston	Boston	1	*90	*90	.....	....
Tenn. C. & C. cfs	New York	11¼	10⅞	11	May '18, I	1.00
Tuolumne	Boston	*70	*60	*65	May '13,	0.10
United Verde Ex.	Boston Curb	27⅛	27⅛	27⅛	Feb. '22, Q	0.25
Utah Consol.	Boston	2	1⅞	2	Sept. '18,	0.25
Utah Copper	New York	64½	62½	63¾	Mar. '22, Q	0.50
Utah Metal & T.	Boston	1⅜	1¼	1⅜	Dec. '17,	0.30
Victoria	Boston	†2	†1½	1⅝	.....	....
Winona	Boston	*30	*30	*30	.....	....
Wolverine	Boston	12	12	12	.....	....
NICKEL-COPPER						
Internat. Nickel	New York	16⅜	15⅞	16⅜	Mar. '19,	0.50
Internat. Nickel, pfd	New York	75	74	75	Feb. '22, Q	1.50
LEAD						
National Lead	New York	91⅞	88	90½	Mar. '22, Q	1.50
National Lead, pfd	New York	113	110½	110¾	Mar. '22, Q	1.75
St. Joseph Lead	New York	13⅜	13	13¼	Mar. '22, Q	0.25
QUICKSILVER						
New Idria	Boston	2	2	2	.....	....
ZINC						
Am. Z. L. & S.	New York	15⅜	14⅛	15⅜	May '20,	1.00
Am. Z. L. & S. pfd	New York	40⅜	39	39½	Nov. '20, Q	1.50
Butte C. & Z.	New York	6½	6	6	June '18,	0.50
Butte & Superior	New York	27⅜	25⅜	25⅝	Sept. '20,	1.25
Callahan Zn-Ld	New York	6⅞	6¼	6½	Dec. '20, Q	0.50
New Jersey Zn	N. Y. Curb	144	142	142	Feb. '22, Q	2.00
Yellow Pine	Los Angeles	*37	*37	*37	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

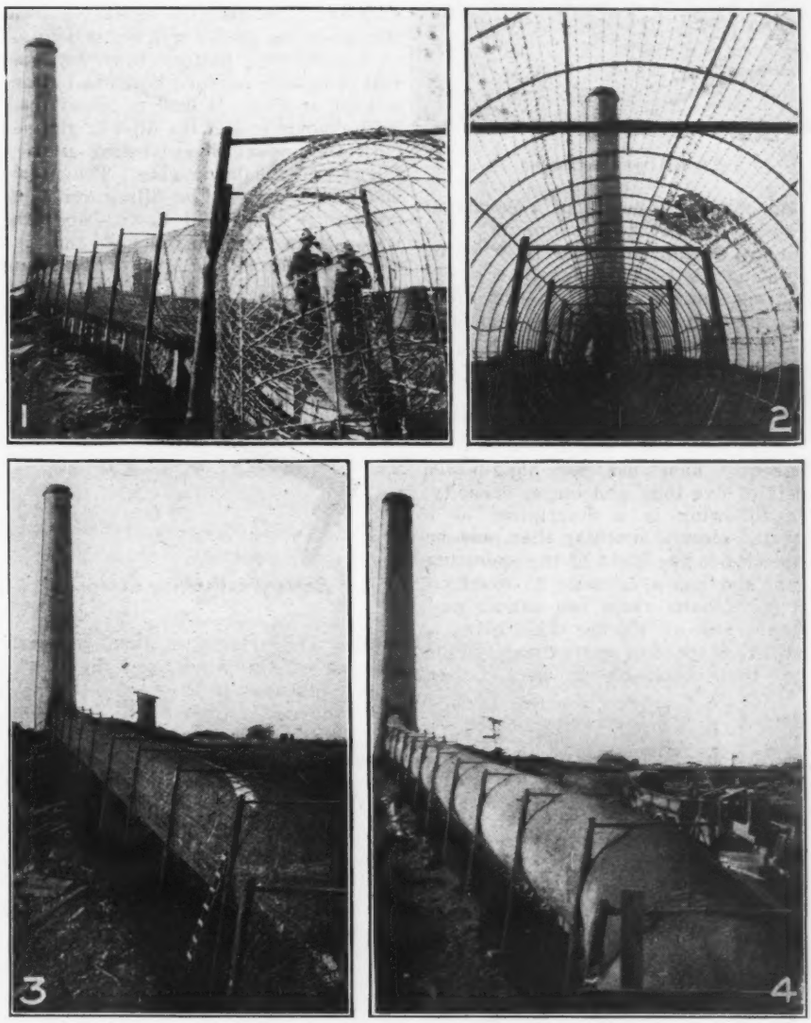
Stock	Exch.	High	Low	Last		Last Div
GOLD						
Alaska Gold	New York	⅜	⅛	⅜	.....	....
Alaska Juneau	New York	1⅛	1	1⅛	.....	....
Carson Hill	New York	16½	15⅜	15⅝	.....	....
Cresson Consol. G	N. Y. Curb	2⅞	2¼	2¼	Jan. '22, Q, X	$0.10
Dome Extension	Toronto	.....	.....	*85	.....	....
Dome Mines	New York	28⅛	25½	26	Jan. '22, Q	0.25
Florence Goldfield	N. Y. Curb	*25	*20	*24	.....	....
Golden Cycle	Colo. Springs	*76	*74	*74	June '21, Q	0.02
Goldfield Consol	N. Y. Curb	*10	*5	*8	Dec. '19,	0.05
Hollinger Consol	Toronto	9.85	9.35	9.50	Mar. '22,	0.05
Homestake Mining	New York	69½	62	69½	Mar '22, M	0.25
Kirkland Lake	Toronto	*47	*40	*45½	.....	....
Lake Shore	Toronto	2.45	2.05	2.35	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	20.40	18.75	19.50	Jan. '22, K	0.05
Porcupine Crown	Toronto	*28½	*25	*26½	July '17,	0.03
Porcupine V. N. T.	Toronto	*32	*29	*31½	.....	....
Portland	Colo. Springs	*35	*32	*33	Oct. '20, Q	0.01
Schumacher	Toronto	*57	*51	*55	.....	....
Silver Pick	N. Y. Curb	*23	*8	*18	.....	....
Teck Hughes	Toronto	*56	*54	*55½	.....	....
Tom Reed	Los Angeles	*66	*61	*61	Dec. '19,	0.02
United Eastern	N. Y. Curb	2	1 13/16	1 13/16	Jan. '22, Q	0.15
Vindicator Consol	Colo. Springs	*18	*18	*18	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*5	*4	*5	.....	....
Yukon Gold	N. Y. Curb	1¼	1	1¼	June '18,	0.02½
SILVER						
Batopilas Mining	New York	1⅛	1⅛	1⅛	Dec. '07, I	0.12½
Beaver Consol	Toronto	*35	*32½	*33	May '20, K	0.03
Coniagas	Toronto	1.50	1.00	1.00	May '21, Q	0.12½
Crown Reserve	Toronto	*21	*19	*20	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3⅜	3¼	3⅜	Jan. '22, Q	0.12½
La Rose	Toronto	*44	*35	*43	Apr. '18,	0.02
McKinley-Dar.-Sav.	Toronto	*22½	*18½	*22	Oct. '20, Q	0.03
Mining Corp. Can	Toronto	1.15	1.05	1.10	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅛	5⅞	5⅞	Jan. '22, Q, X	0.30
Ontario Silver	New York	9	7½	7½	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	.....	.....	*12	Jan. '12,	0.10
Temiskaming	Toronto	*40	*34½	*35	Jan. '20, K	0.04
Trethewey	Toronto	*4¼	*3½	*3½	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*36	*26	*27	.....	....
Cash Boy	N. Y. Curb	*5	*5	*5	.....	....
Dolores Esperanza	N. Y. Curb	1⅜	*1⅛	1⅛	.....	....
El Salvador	N. Y. Curb	*8	*4	*4	.....	....
Jim Butler	N. Y. Curb	*9	*8	*9	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	*4	*4	*4	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*12	*10	*10	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1⅛	1⅛	1⅛	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*67	*60	*67	.....	....
Tonopah Extension	N. Y. Curb	1⅛	1⅛	1⅛	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1 1/16	1¼	1⅛	Oct. '21, SA	0.05
West End Consol	N. Y. Curb	1¼	1 1/16	1 3/16	Dec. '19, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	.....	.....	*6	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*97	*93	*93	Dec. '20,	0.15
Chief Consol	Boston Curb	3⅛	3⅛	3⅛	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	20½	19½	20	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†3.00	†1.25	...	July '20, Q	0.10
Daly-West	Boston	†2	†1⅞	2¼	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	2⅛	2⅛	2⅛	Apr. '21, K	0.05
Electric Point	Spokane	*7	*5½	*5½	May '20, SA	0.03
Federal M. & S.	New York	10	9¼	9⅜	Jan. '09,	1.50
Federal M. & S. pfd.	New York	39	38½	38½	Mar. '22, Q	1.00
Florence Silver	Spokane	*24½	*24	*24½	Apr. '19,	0.01½
Grand Central	Salt Lake	*54	*53	*54	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6	5⅞	5⅞	Mar. '22, Q	0.15
Iron Blossom Con	N. Y. Curb	*21	*21	*21	Dec. '21, Q	0.02½
Judge M. & S.	Salt Lake	†3.50	†2.75	3.00	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*9	*6	*9	June '21, I	0.02
Prince Consol	Salt Lake	*8½	*8	*8	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*5½	*5	*5	Feb. '19,	0.01
Rex Consol	N. Y. Curb	*8	*7	*7	.....	....
South Hecla	Salt Lake	†*60	†*35	...	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*16	*16	*16	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*11	*8	*11	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.25	2.25	2.25	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.02½	1.95	1.97½	Dec. '21, Q	0.05
Utah Apex	Boston	3¼	3⅛	3⅛	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	....	....	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp	New York	39⅜	37½	38¾	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp	Montreal	56½	54½	56½	Jan. '22, Q	1.50
Asbestos Corp. pfd	Montreal	78	76	78	Jan. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	17½	16⅜	17½	Nov. '19, Q	1.00
Texas Gulf	New York	42⅜	40½	42	Mar. '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	54	50¾	53¾	Mar. '21, Q	1.00
Amer. Sm.& Ref. pf.	New York	97½	95	97½	Mar.'22 Q	1.75
Am. Sm. Sec. pf. A	New York	90	90	90	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	37½	35⅞	36½	Jan. '21, Q	0.50
U.S. Sm.R.& M. pf.	New York	46½	45	47⅛	Jan. '22, Q	0.87½

NEW MACHINERY AND INVENTIONS

"Guniting" a 225-Ft. Flue

The following is a description of a flue that was constructed by the Calaveras Copper Co. to connect the dust chamber with the stack at the company's 300-ton smelter at Copperopolis, Cal. This flue is 225 ft. long, 8 ft. in diameter, and is shown in photographs 1 and 2, the reinforcing steel being entirely assembled.

The vertical supports, slightly inclined, are made of 4-in. boiler tubes set in concrete piers, and are tied together at the top. The reinforcing for the main flue consists of ½-in. rods, spaced horizontally circular with 2-ft. centers, tied together, and welded at the intersections. On top of these rods, as shown in photograph 2, was secured 7-A triangular mesh screening. The circular ½-in. diameter ribs were bent up and welded to make several rings. As stated above, all this steel reinforcing was entirely assembled and was self-supporting. The next step was to apply heavy tarpaulin, or canvas, to the outside of the steel reinforcing, and "gunite" was then shot on the inside, the lower half of the flue being shot first. The canvas backing was moved along the flue as the work progressed. After the interior of the flue had been shot (see photograph 3) the exterior of the flue was shot, the completed flue being shown in photograph 4. A three-to-one mixture of sand and cement was used. The slope of the flue is about 25 deg. from the horizontal, and the average thickness of the "gunite" is 2 in.



Constructing a flue at Copperopolis, Cal.

Motors for Mine Pump Service

There has recently been developed a direct-current motor especially built for operating mine pumps. The design and construction of the motor is the result of investigation of conditions under which mine pumps operate.

Six different sizes and ratings are built, but the design and construction is standard for each size. They are compound wound with approximately 15 per cent series winding, having four main field and two commutating field poles. All field poles are laminated and bolted to the frame. The frames are cast steel, octagonal in shape, and provided with a large hole in the bottom for drainage of any water that may accumulate inside the frame. The leads are brought out through heavy insulating bushings to connection plate on the side of the frame. Stamped markings on both the bushings and the connection plate above each lead show the external connections for both directions of rotation.

The motors are not designed to run totally inclosed, but as a protection against water there is a sheet-metal top half cover on the commutation end, the end shield on the pinion end being cast solid on top. A new feature in this motor is the large bearing housings on the end shields, equipped with waste-packed bearings. The end shields complete including brush holders, studs, and bearing housings. The latter are interchangeable on all types except one, the 230 v., which requires larger brushes.

On all sizes except the 550 v., the brush holder studs are assembled directly on the end shield. The large commutator on the 550-v. motors requires a special bracket, which is fastened to the end shield. Brush shifting is done by turning the whole end shield, the bolt holes being drilled large enough to allow all the rotation necessary. When the proper brush position is determined, the end shield is doweled to the frame, and its bolts are tightened. The brush holders are specially designed, and so constructed to prevent chattering or the rocking of the brushes in the holder. The design is a development of the General Electric Co.

A Convenient Small Hoist

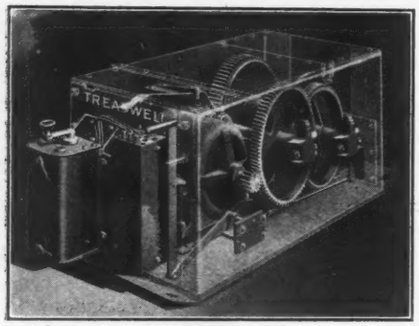
A self-contained, small portable hoist which is suitable for light hoisting and hauling, is mechanically dependable, safe from injury to its mechanism, and protected in such a way as to prevent injury to workmen finds ready application for all sorts of odd jobs, both above and below ground. Its work comprises everything from hauling cars, placing machinery on foundations, skidding timbers, and loading concrete forms, to handling a slusher in underground work.

Such a machine is shown in the illustration on the next page. This hoist is wholly inclosed in a heavy sheet-steel plate casing and mounted on ½-in. steel sole plate. The unit casting forms the support for the drum and gear shaft bearings, the latter being electric steel castings, fitted with renewable bronze bushings and lubricated from a waste-packed oil reservoir. The controller box and resistance panel are, of necessity, mounted on the exterior of the casing. All other mechanism and the motor are entirely inclosed.

The hoist is provided with a clutch manipulated by a lever at the operator's end of the hoist, which lever is automatically locked either "in" or "out." Control of the load is effected by a powerful hand-brake, whose controlling hand-lever is conveniently placed. This brake-lever is normally latched in an "off" position, allowing the hoist drum to run free. A remov-

able door or cover is provided on the top of the casing to give easy access to the mechanism within. All parts except the barrel of the rope drum are made of steel.

The 8 x 12 in. drum has a capacity of 1,500 ft. of ⅝-in. wire rope and a



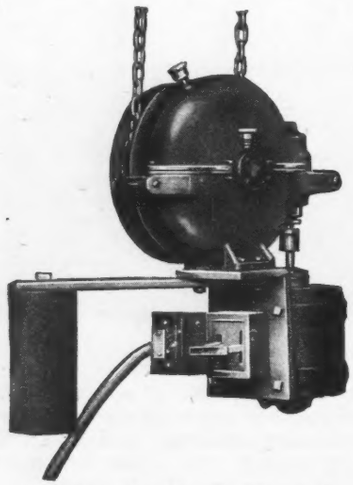
Small inclosed hoist

rated hoisting capacity of 1,500 lb. at a speed of 100 ft. per minute. The standard motor employed is of 5 hp. operating at 1,200 r.p.m. The entire hoist measures 2 x 2 x 4½ ft. over all.

This new product has been developed by the Treadwell Engineering Co., at Easton, Pa.

An Electric-Driven Chain Hoist

Mine, mill, and smelter operators frequently have use for hand-power hoists of five tons' and larger capacity. The following is a description of a patented electric machine that may be suspended in the bight of the operating chain, and has a capacity to overhaul 138 ft. of hand chain per minute and a chain pull of 130 lb. This gives a load-lifting speed of approximately four times that obtainable by hand power



Chain hoist with electric drive

and requires only one man for operation.

Current may be supplied by a flexible conductor from convenient sockets or suspended from the hoist if more desirable to bring feeders to that point. The machine balances itself, weighs about 160 lb., and is easily handled. The gears are hardened and run in oil, and the machine can be furnished for operation on both alternating and direct current. The New Jersey Foundry & Machine Co., 90 West St., New York City, manufactures the hoist.

An Ingenious Device for Filling Storage-Battery Cells

By means of a cleverly devised tool, the exact amount of water necessary to fill storage-battery cells is permitted to flow into the cells without overflowing or causing the electrolyte to slop over. In addition to saving time, the use of the device will materially aid in keeping the battery tops dry, and will be equally useful where one battery is kept or where a fleet is maintained.

The barrel end of the filler is grasped with the index finger resting upon a trigger on the lower side. The nozzle end is inserted in the filling vent, the trigger is then held down, and the water flows through the hose into the cell. As soon as the level of the liquid reaches the proper height, a contact is made and a small electric bulb signal

Battery cell-filling device

lights. The trigger is then released, shutting off the water, and the operation is repeated in the next cell.

The device is known as the Exide Cell Filler and is the invention of and manufactured by the Electric Storage Battery Co., of Philadelphia, Pa.

TRADE CATALOGS

Traylor Machinery—The Traylor Engineering & Manufacturing Co., of Allentown, Pa., and with branch offices at New York, Chicago, Pittsburgh, Los Angeles, and Spokane, has issued Bulletin 1,000, which consists of a pocket edition of the company's general catalog. Condensed information is given concerning crushing and grinding machinery, furnaces, classifiers, jigs, mine skips and cages, pumps, and compressors.

Mine Pumps—Catalog No. 15, issued by the Prescott Co., Menominee, Mich., covers the subject of mine pumps—electric and steam—in an excellent manner. The illustrations are beautifully done and the issue does credit to the company. There is also included a number of tables and engineering data. Prescott pumps need no introduction to mining men, but the descriptions of the various types will prove interesting to those who are not familiar with all of them.

Pump Bearings—The Oliver Sherwood Co., of 505 Market St., San Francisco, Cal., has issued a bulletin bearing the title "Cutless Bearings," which describes the uses and advantages of an "Olivite" rubber bearing for pumps. A number of objections made to the use of rubber bearings are given in the pamphlet and arguments in favor of their use are presented.

Controllers—A simple description of controllers for electric motors and definitions of the terms used in that connection have been compiled by the Electric Power Club and published in a handbook. Words which do not appear in the regular dictionaries are here explained in simple language, and in addition to being a handbook for users of electrical control apparatus, the volume gives the meaning of terms with which all users of electrical apparatus should be familiar. The handbook may be obtained from leading manufacturers of electric power and control apparatus, or from S. N. Clarkson, executive secretary, 1017 Olive St., St. Louis, Mo.

Couplings — The function of the Whitney free-floating coupling is to transmit power from one shaft to another, though the shafts are not in alignment, without causing strains in the shafts or bearings. This is accomplished by the power being transmitted through the free floating center link which fits into sockets in the hubs so that it is free to rock in any direction and float laterally and yet is of such design as to give a positive drive. The action of these couplings is in no way accomplished by the bending or otherwise distorting of any of its members, and therefore limited by the fatigue of material, but is due entirely to the geometric design of the center link. Further particulars are furnished in Circular No. 1922, issued by the Kay Manufacturing Co., Norwalk, Conn.

Compressors—Bulletin No. 407, issued by the Bury Compressor Co., of Erie, Pa., describes the Bury Universal three-cylinder, two-stage compressor. This type includes among its special features the square type, rolling-mill style frame; broad, deep and well reinforced with heavy ribs with ample support under its entire length and breadth; large main bearing surfaces in removable shells, easy of adjustment and removal; thorough and copious automatic lubrication; automatic patented pyramid box plate intake and discharge valves with the largest areas, insuring light work, low velocity of air through valves and low power cost with high efficiency, noiseless in operation, and most simple.